

Cachuma Project Water Rights Hearing

October 2003

Panel I

Presenter:

Antonio M. Buelna, P.E.

Chief, Operations Division

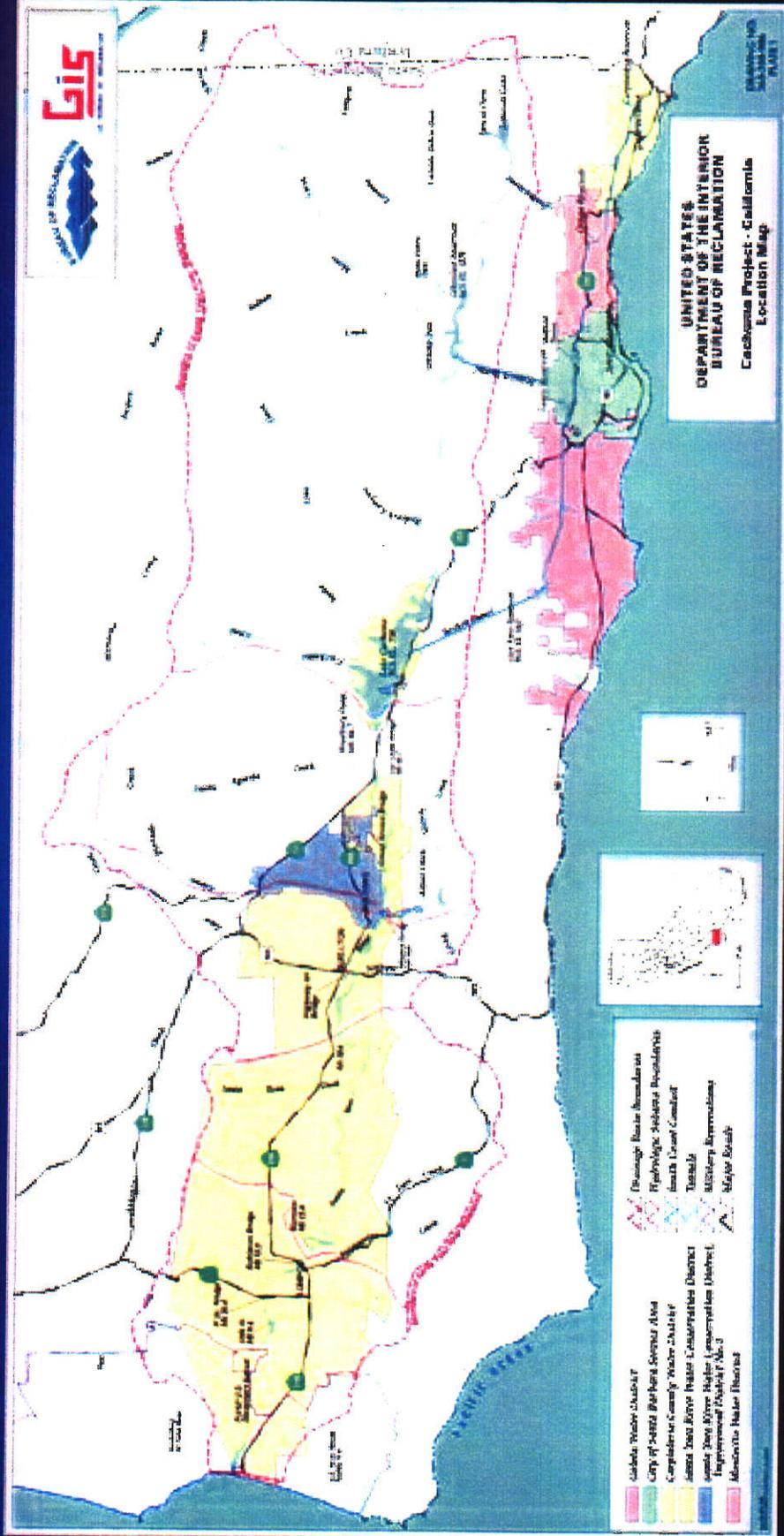
US Bureau of Reclamation

South-Central California Area Office

Cachuma Project

- Constructed in 1950-1956
- Storage in Lake Cachuma began in 1952
- Total Storage Capacity: 189,240 acre-feet
- 28 Miles of Pipeline
- 7.5 Miles of Tunnels
- 100 Miles of Laterals

Cachuma Project



Cachuma Project Facilities

- Bradbury Dam & Lake Cachuma
- Tecolote Tunnel
- South Coast Conduit
 - Glen Anne Dam & Reservoir
 - Lauro Dam & Reservoir
 - Ortega Dam & Reservoir
 - Carpinteria Dam & Reservoir
- Distribution Systems
 - Goleta Water District
 - City of Santa Barbara
 - Montecito Water District
 - Summerland County Water District (now part of Montecito WD)
 - Carpinteria Valley Water District

Cachuma Project



Bradbury Dam/Lake Cachuma

- Zoned earth-fill embankment
- 279 feet high
- 3,350 feet crest length
- 6.7 million cubic yards of material
- Current storage capacity: 188,030 acre-feet
- Covers 3,000 acres with 40 miles of shoreline
- Spillway
 - Concrete-lined ogee crest
 - Controlled by four 50x30 feet radial gates
 - 160,000 CFS capacity
- River outlet works
 - Two 30” fixed-cone valves & one 10” butterfly valve
 - Current capacity: 150 CFS

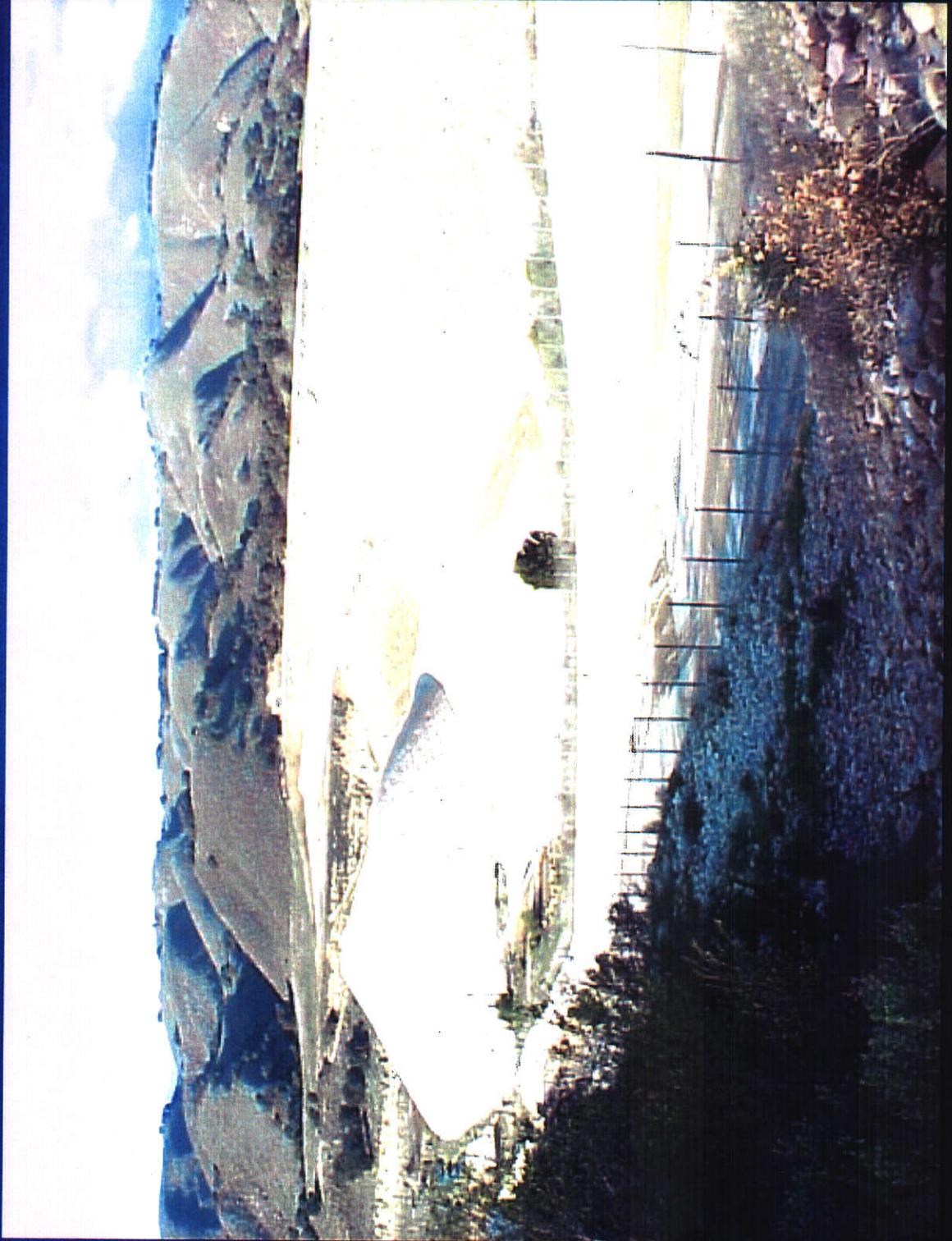
Bradbury Dam/Lake Cachuma

(continued)

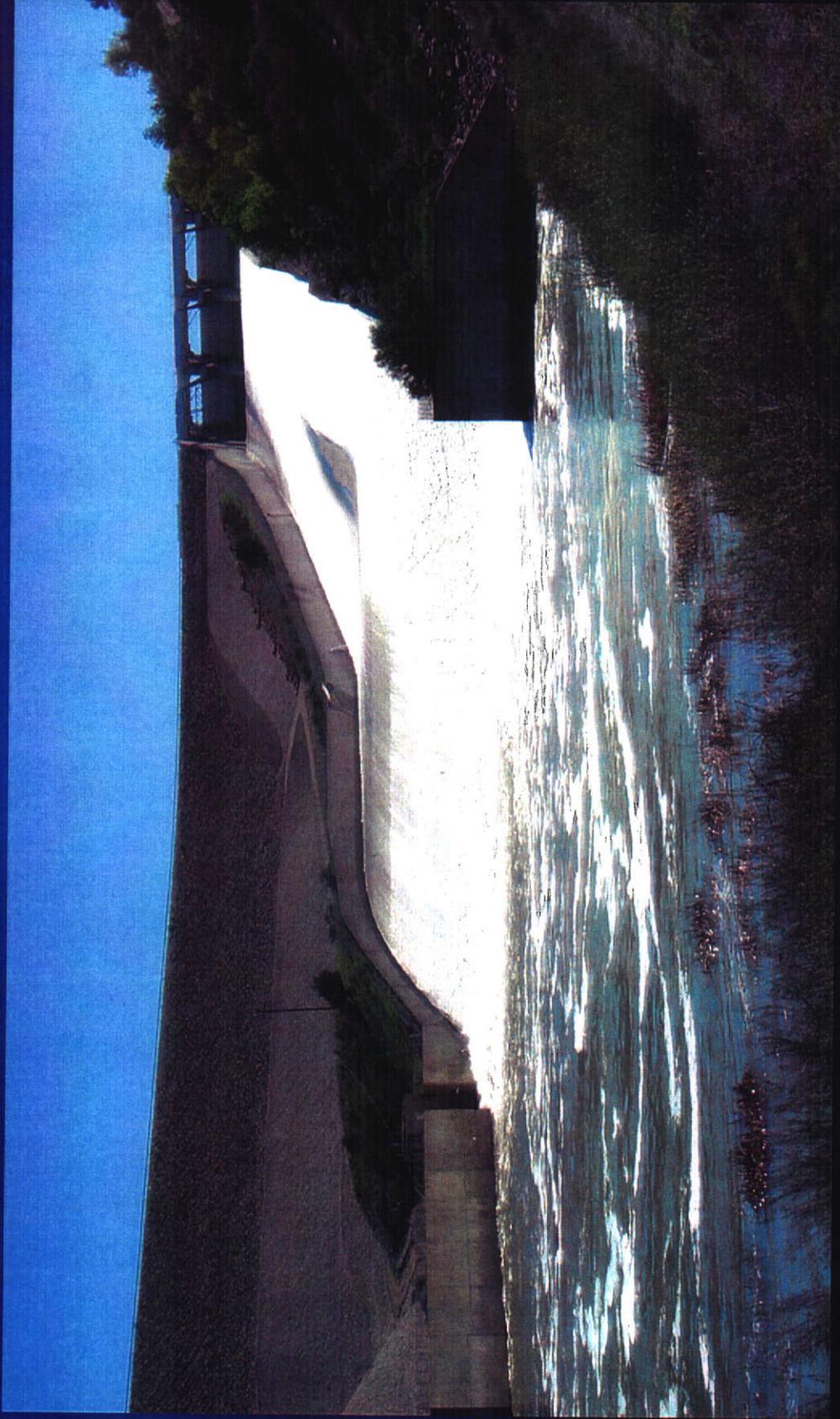
- Hilton Creek Water Supply Pipeline
 - Delivers water from the reservoir to Hilton Creek
 - Current Capacity: 5 cfs
 - Modifications scheduled in 2004 to increase capacity to 10 cfs

- State Water Project Connection at River Outlet Works
 - Central Coast Water Authority
 - Warren Act Contract Number 5-07-20-W1282
 - Allows delivery of State Water Project water into Lake Cachuma for temporary storage and release into the Tecolote Tunnel for delivery to the Santa Barbara Area
 - Connection capacity: approximately 22 cfs

Bradbury Dam



Bradbury Dam - Spillway



Tecolote Tunnel & South Coast Conduit

- Tecolote Tunnel
 - 6.4 miles through the Santa Ynez Mountains
 - 7-foot-diameter, concrete lined, free-flow tunnel
 - Design capacity: 100 cfs
- South Coast Conduit (SCC)
 - High-pressure concrete pipeline
 - 48 to 27 inches in diameter
 - Sheffield Tunnel
 - 6-foot-diameter, horseshoe shaped tunnel
 - 6,000 feet long
 - SCC pipeline passes through tunnel

South Coast Conduit System

- Glen Anne Dam & Reservoir
 - Earth-fill embankment: 135 feet high & crest length of 240 feet
 - Reservoir capacity: 470 acre-feet
 - Spillway: uncontrolled concrete lined, uncontrolled, chute
- Lauro Dam & Reservoir
 - Earth-fill embankment: 137 feet high & crest length of 540 feet
 - Reservoir Capacity: 640 acre-feet
 - Spillway: Concrete intake, 30” concrete pipe, vertical stilling well
- Ortega Dam & Reservoir
 - Earth-fill embankment: 131 feet high & crest length of 430 feet
 - Concrete lined basin: 60 acre-feet
 - Inlet-outlet works and overflow spillway
- Carpinteria Dam & Reservoir
 - Four-sided earth-fill embankment: 31 feet high & crest length of 1,350 feet
 - Concrete lined basin: 40 acre-feet
 - Inlet & outlet pipelines and overflow spillway

Modified Storm Operations

- Project was not authorized as a flood control project
- No storage space dedicated to flood control
- Project has provided incidental flood control benefits
- Changing operating procedures during certain storm events can reduce the risk to the public downstream

Modified Storm Operations

- Report of Modified Storm Operations – Bradbury Dam, Cachuma Project – Santa Barbara County, California – December 29, 1998
- Technical Memorandum No. BR-8130-RA-TM-00-2, US Bureau of Reclamation, Technical Service Center – February 2000
 - Risk-based evaluation to assess the impact to the dam safety risk
 - Conclusions:
 - Reduced out-of-channel flows downstream
 - Incremental increased dam safety risk at the dam is small and risks from various failure modes appear to be well within Reclamation criteria

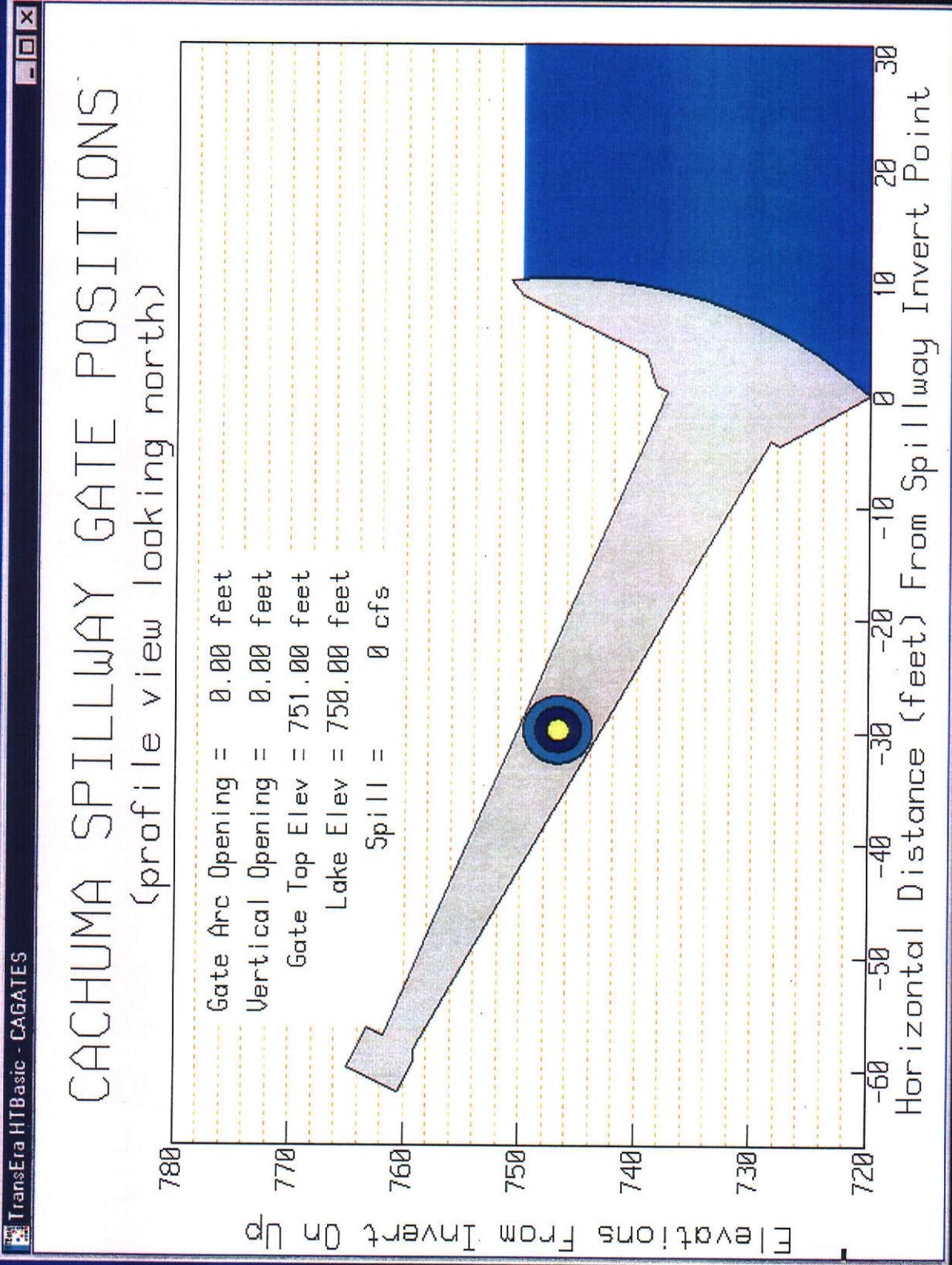
Modified Storm Operations

- Precautionary Releases
 - To draw down the reservoir in preparation of large storms
- Pre-Releases
 - Rates up to the maximum calculated inflow
 - To hold the reservoir at the draw down stage until the storm inflows recede
- Gate Holding
 - Surcharge the reservoir to provide additional reservoir capacity

Modified Storm Operations

Gate Operations Simulation
RULE CURVE

Rule Curve Example - Res El = 750



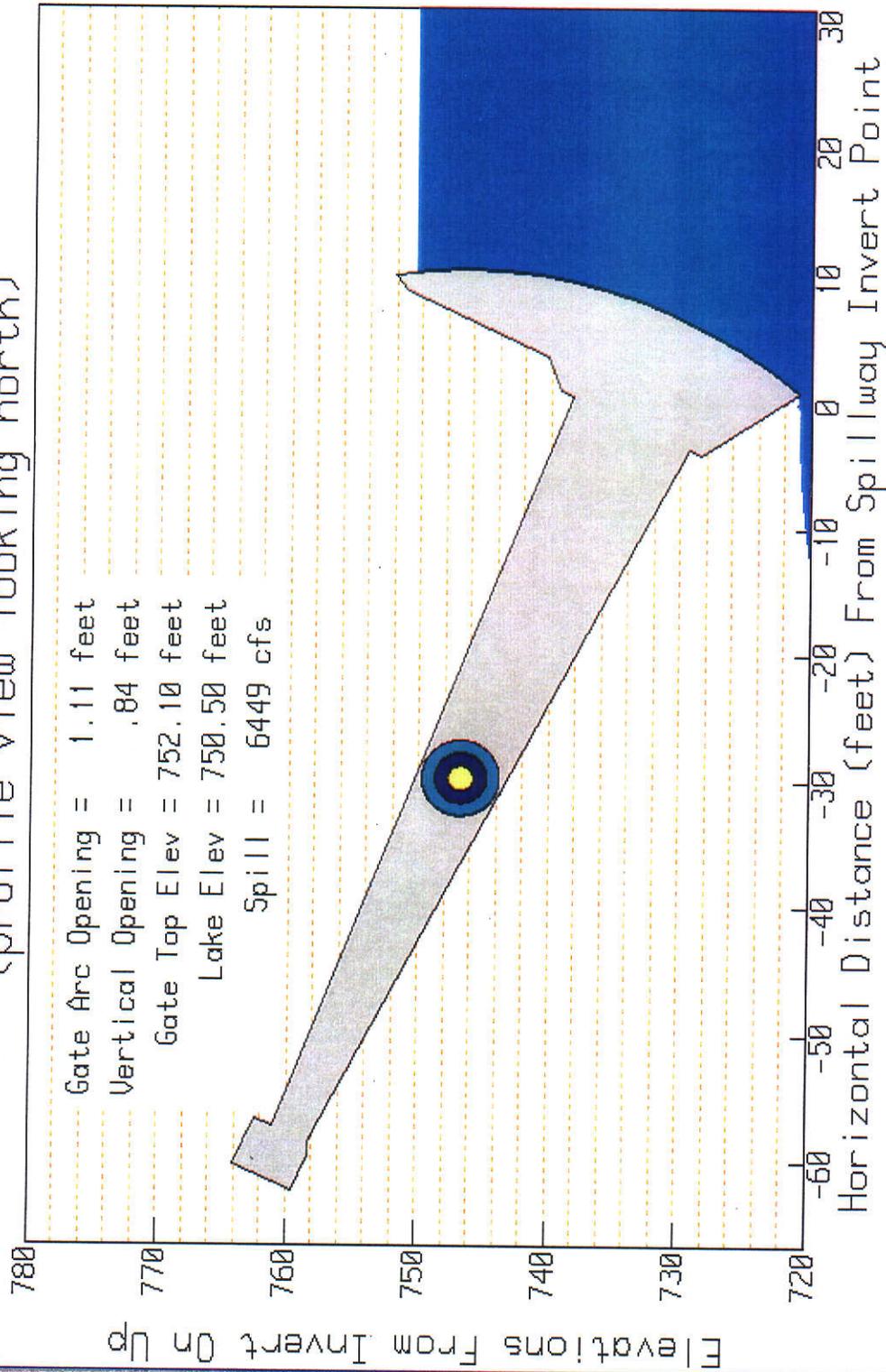
Rule Curve Example - Res El = 750.5

TransEra HTBasic - CAGATES

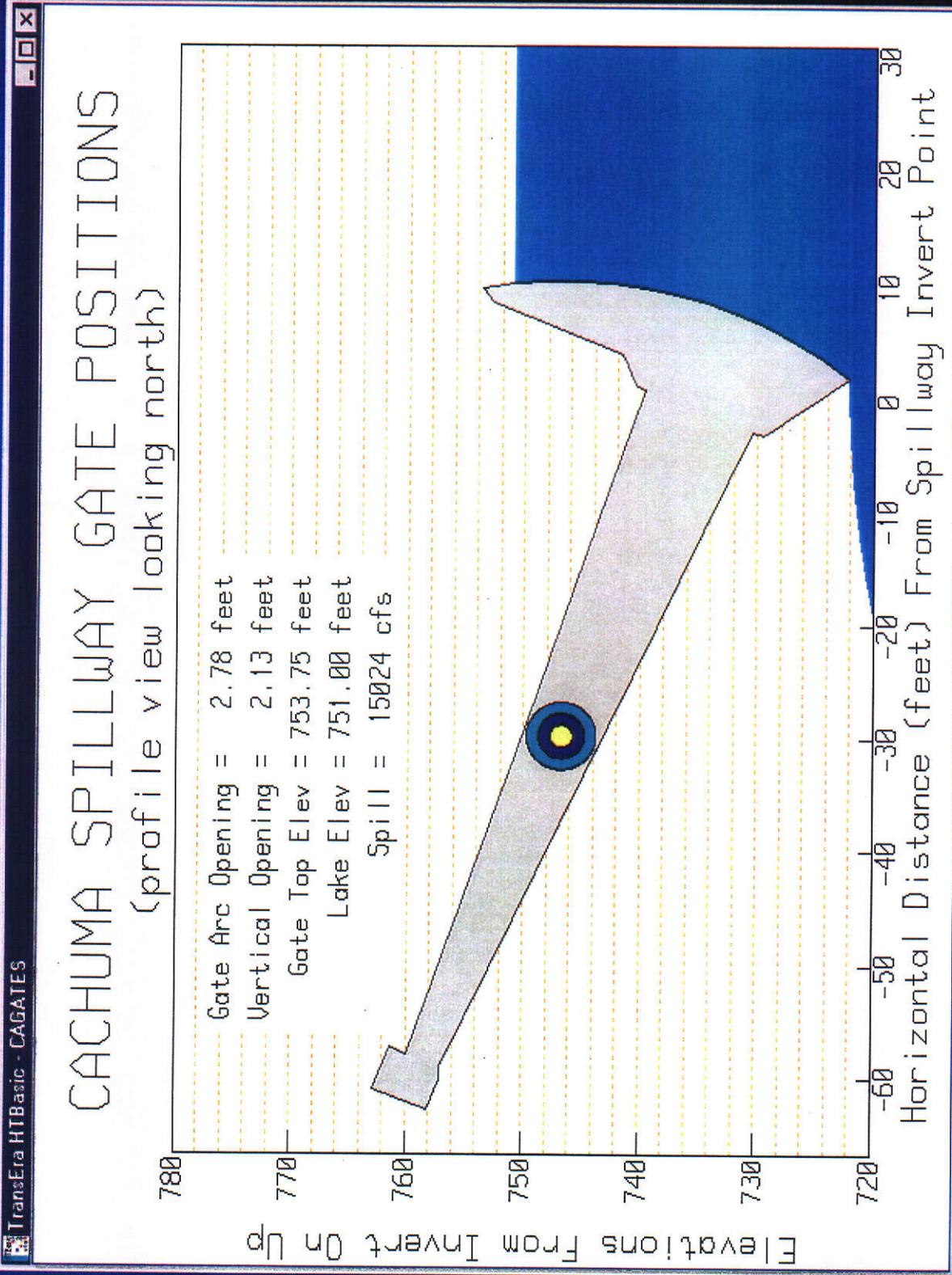
CACHUMA SPILLWAY GATE POSITIONS

(profile view looking north)

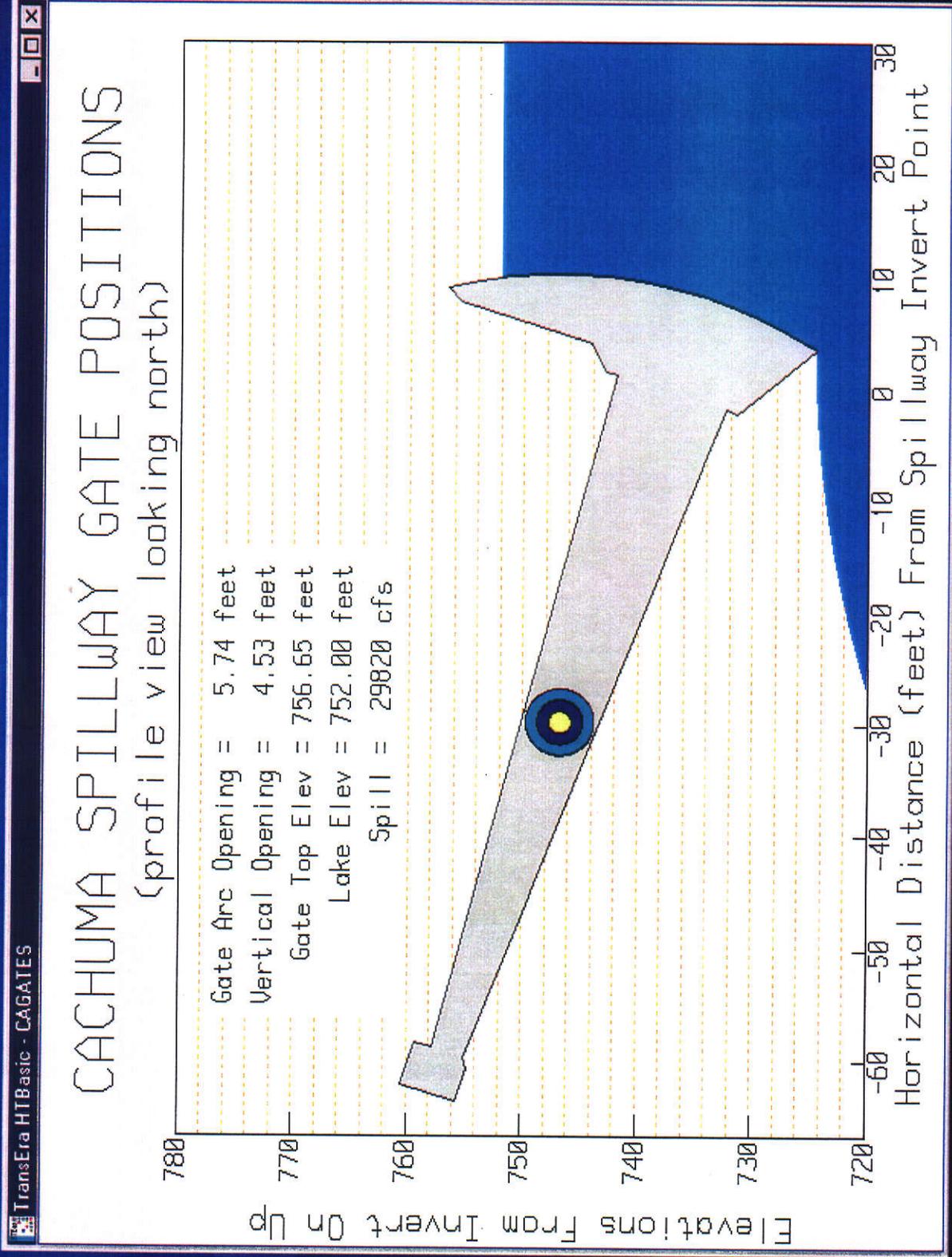
Gate Arc Opening = 1.11 feet
Vertical Opening = .84 feet
Gate Top Elev = 752.10 feet
Lake Elev = 750.50 feet
Spill = 6449 cfs



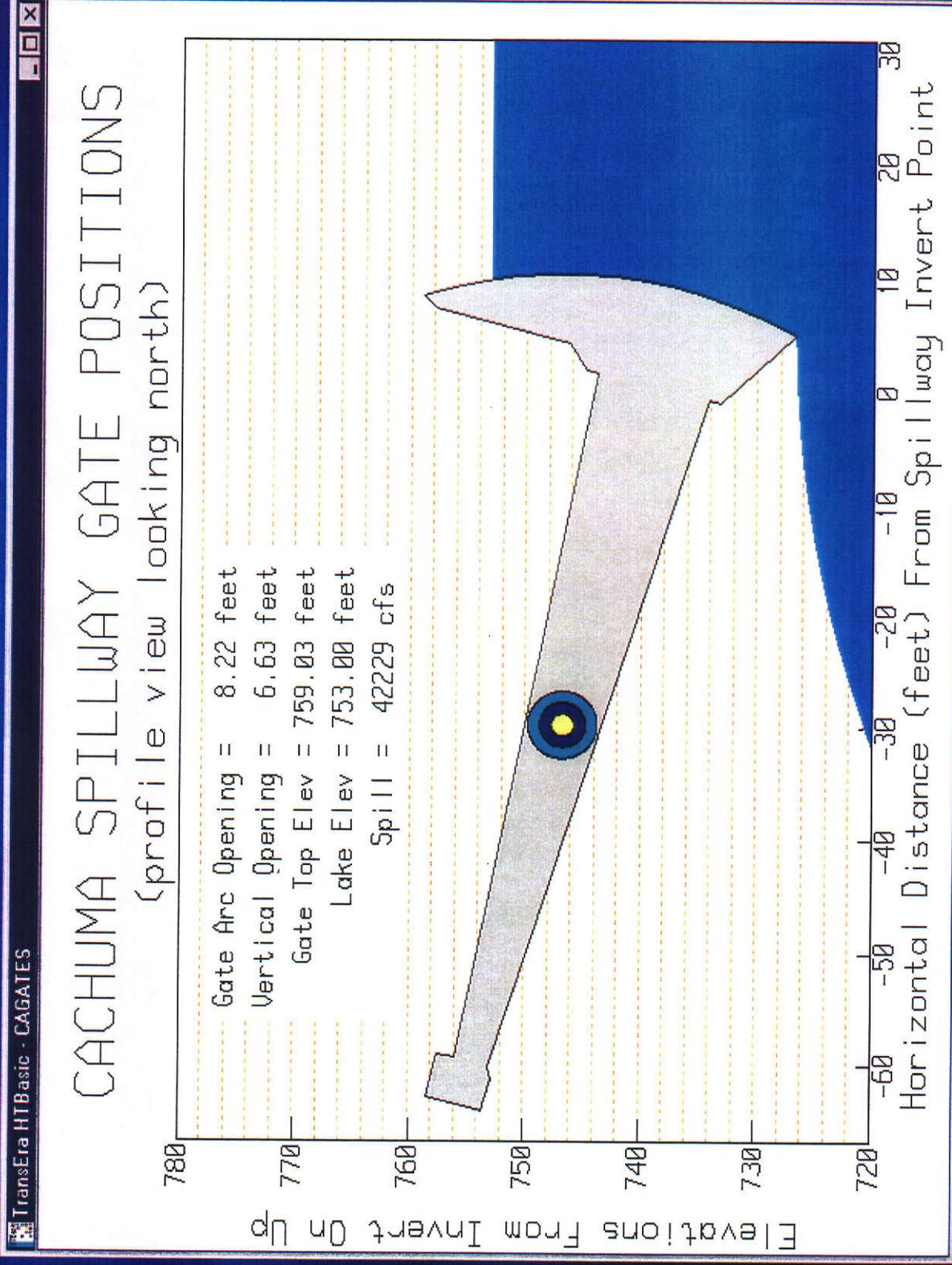
Rule Curve Example - Res El = 751



Rule Curve Example - Res El = 752



Rule Curve Example - Res El = 753



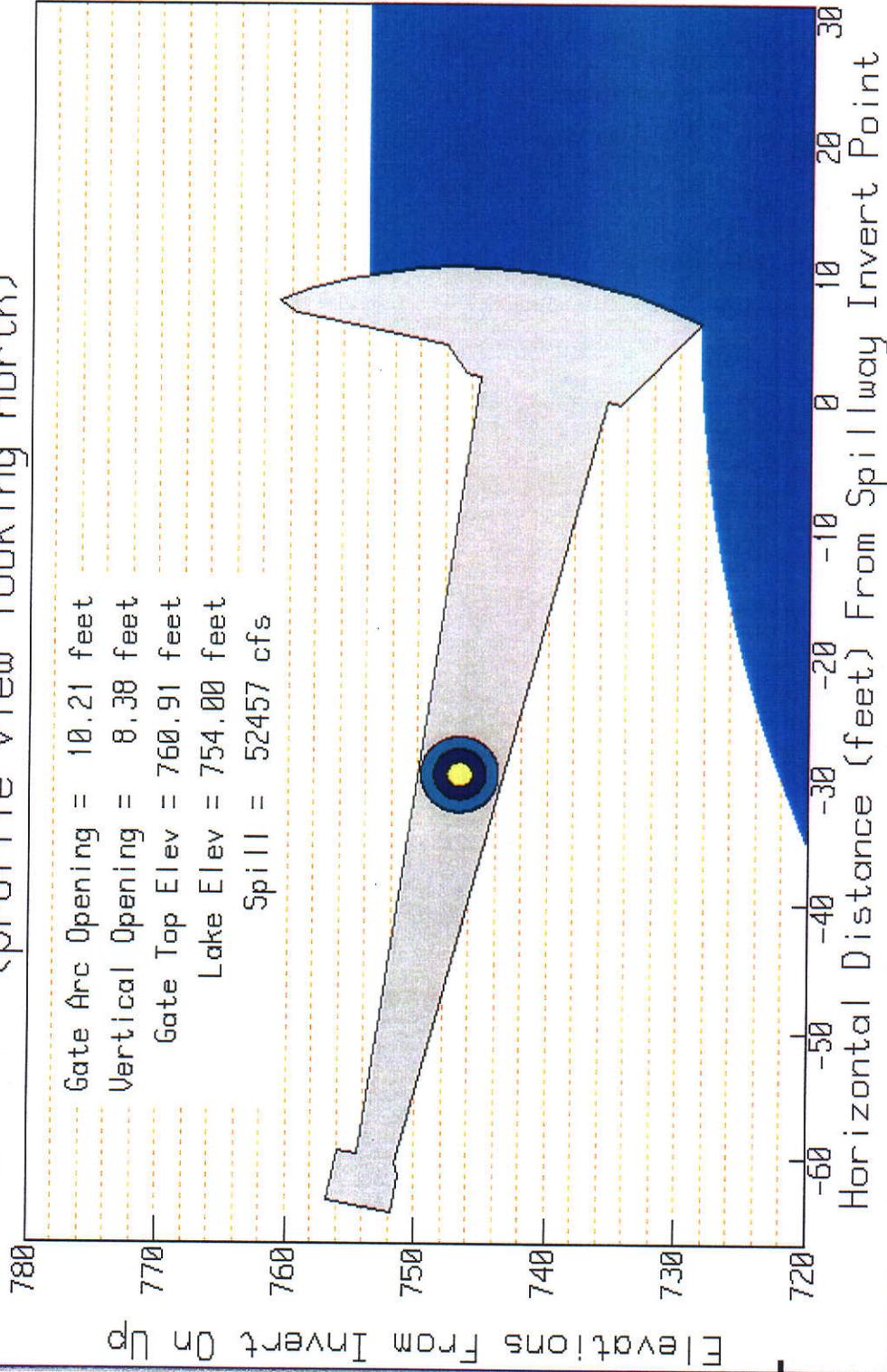
Rule Curve Example - Res El = 754

TransEra HTBasic - CAGATES

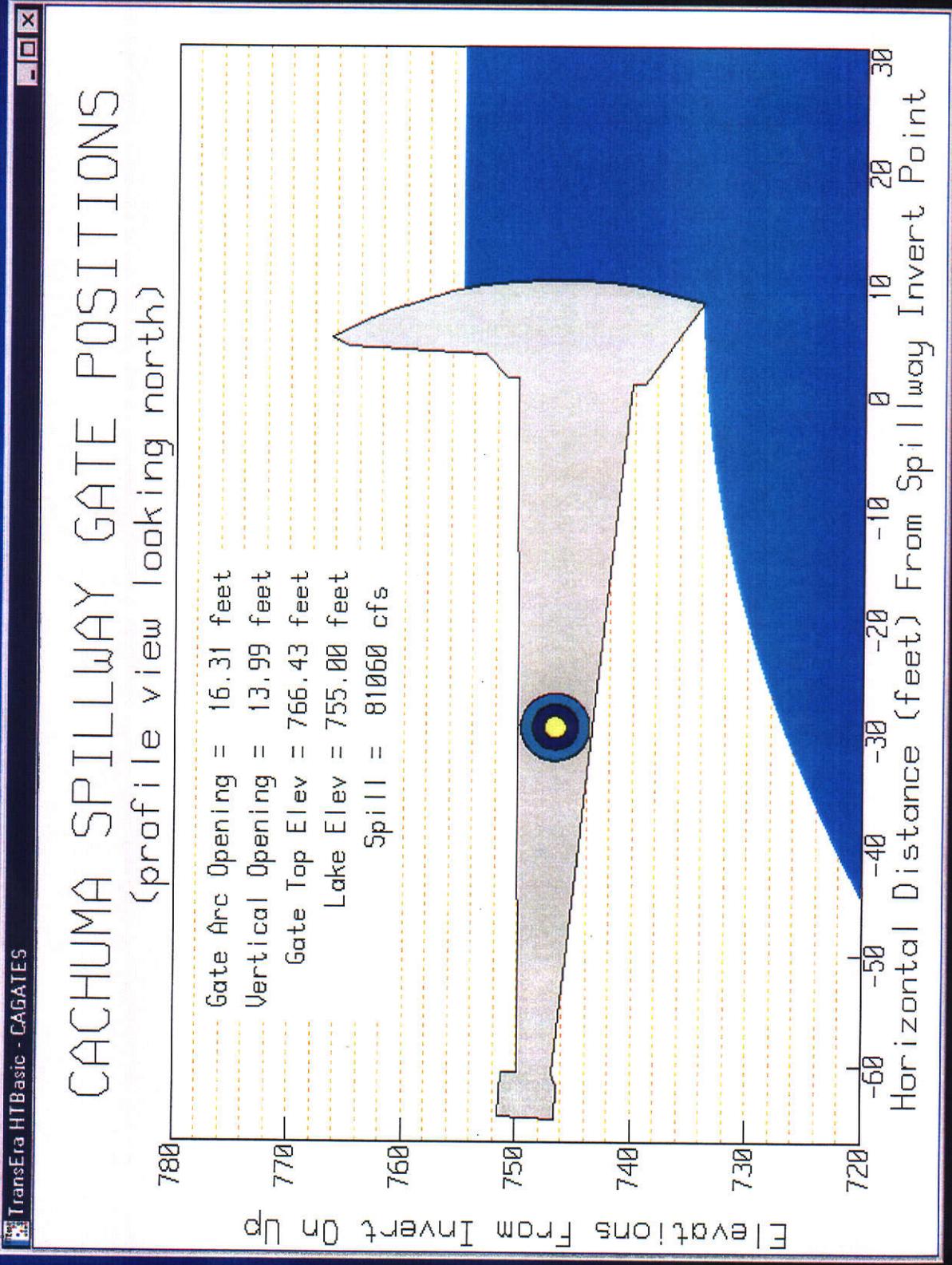
CACHUMA SPILLWAY GATE POSITIONS

(profile view looking north)

Gate Arc Opening = 10.21 feet
Vertical Opening = 8.38 feet
Gate Top Elev = 760.91 feet
Lake Elev = 754.00 feet
Spill = 52457 cfs



Rule Curve Example - Res El = 755



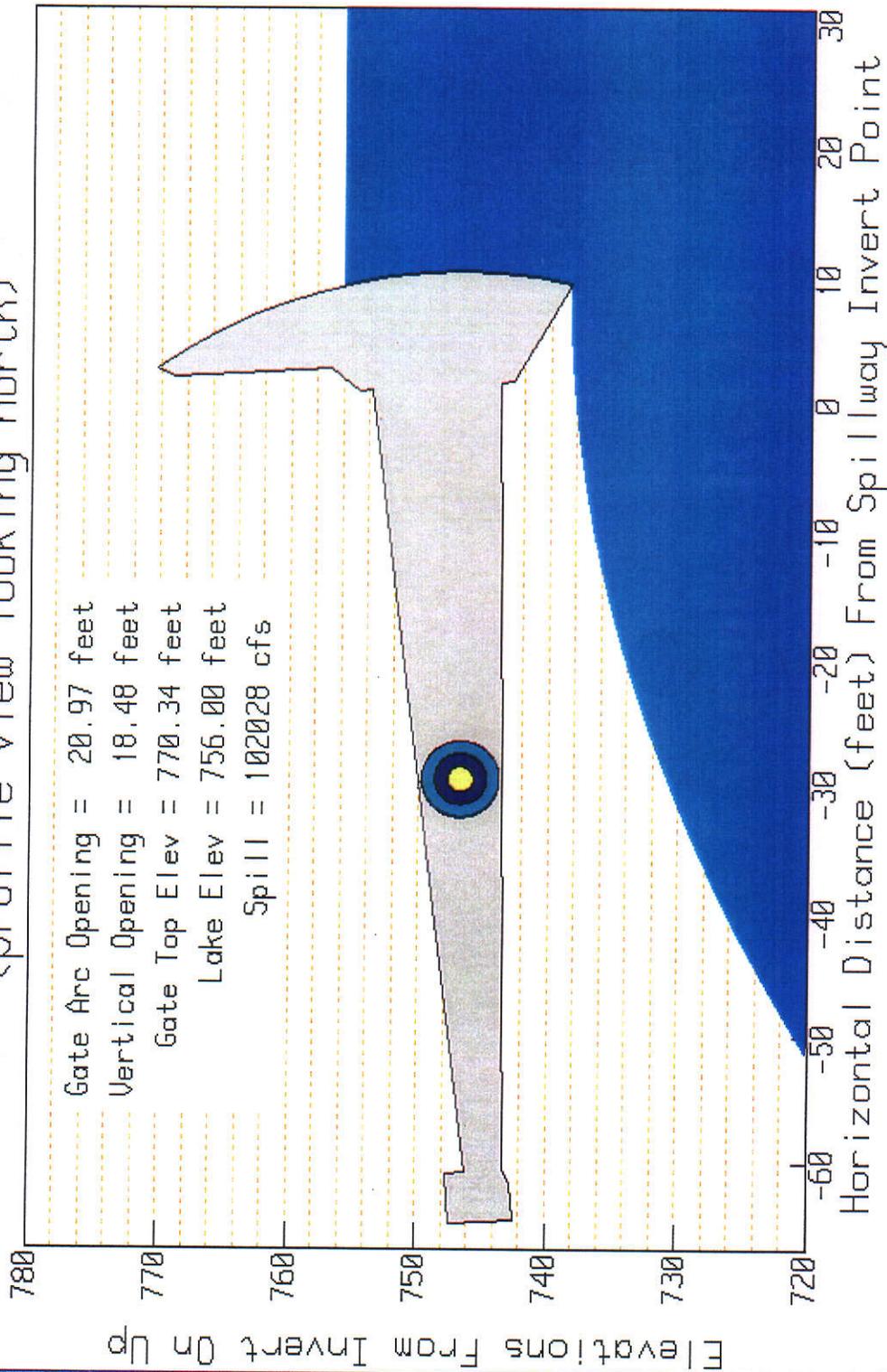
Rule Curve Example - Res El = 756

TransEra HTBasic - CAGATES

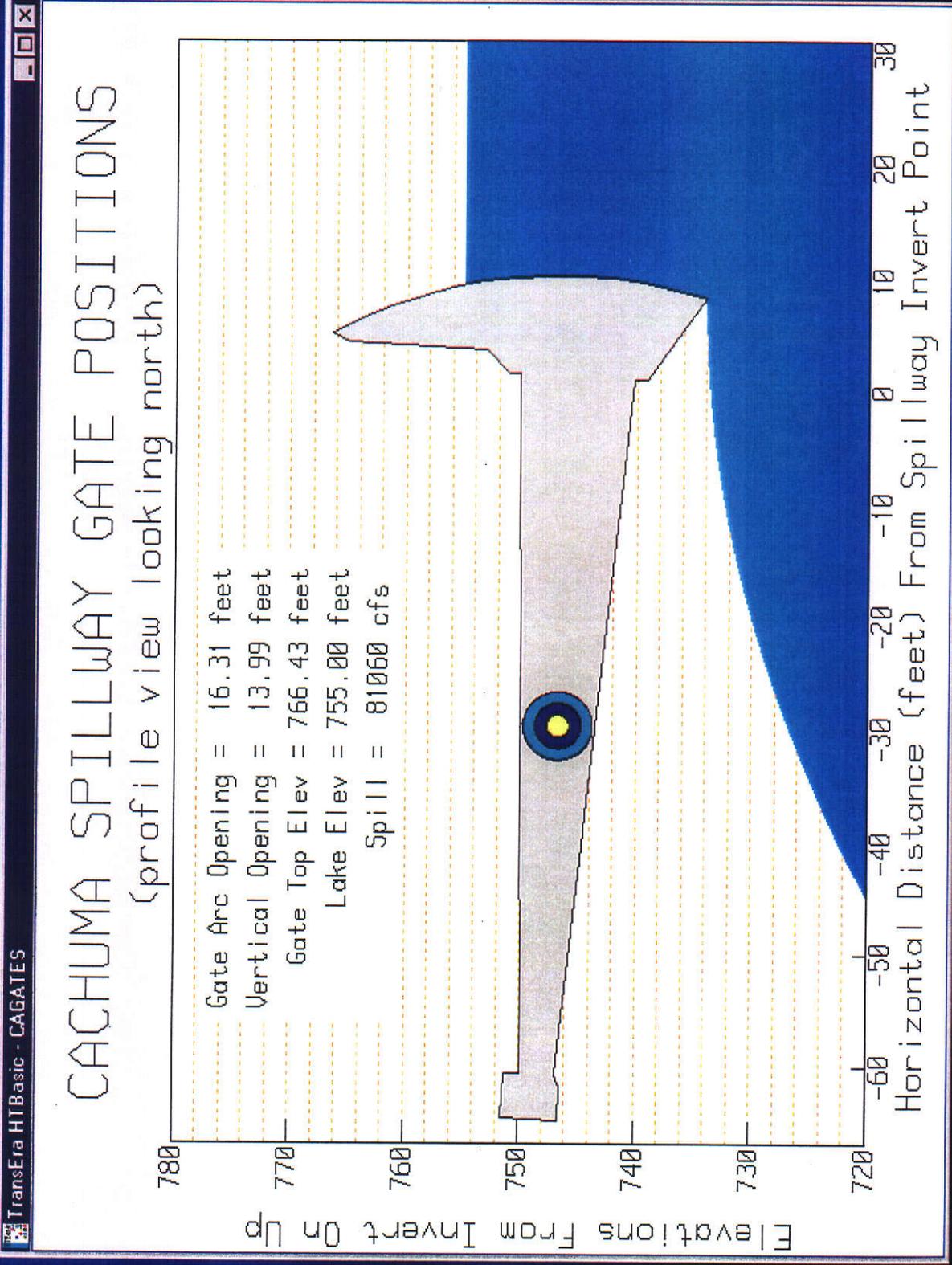
CACHUMA SPILLWAY GATE POSITIONS

(profile view looking north)

Gate Arc Opening = 20.97 feet
Vertical Opening = 18.48 feet
Gate Top Elev = 770.34 feet
Lake Elev = 756.00 feet
Spill = 102028 cfs



Rule Curve Example - Res El = 755



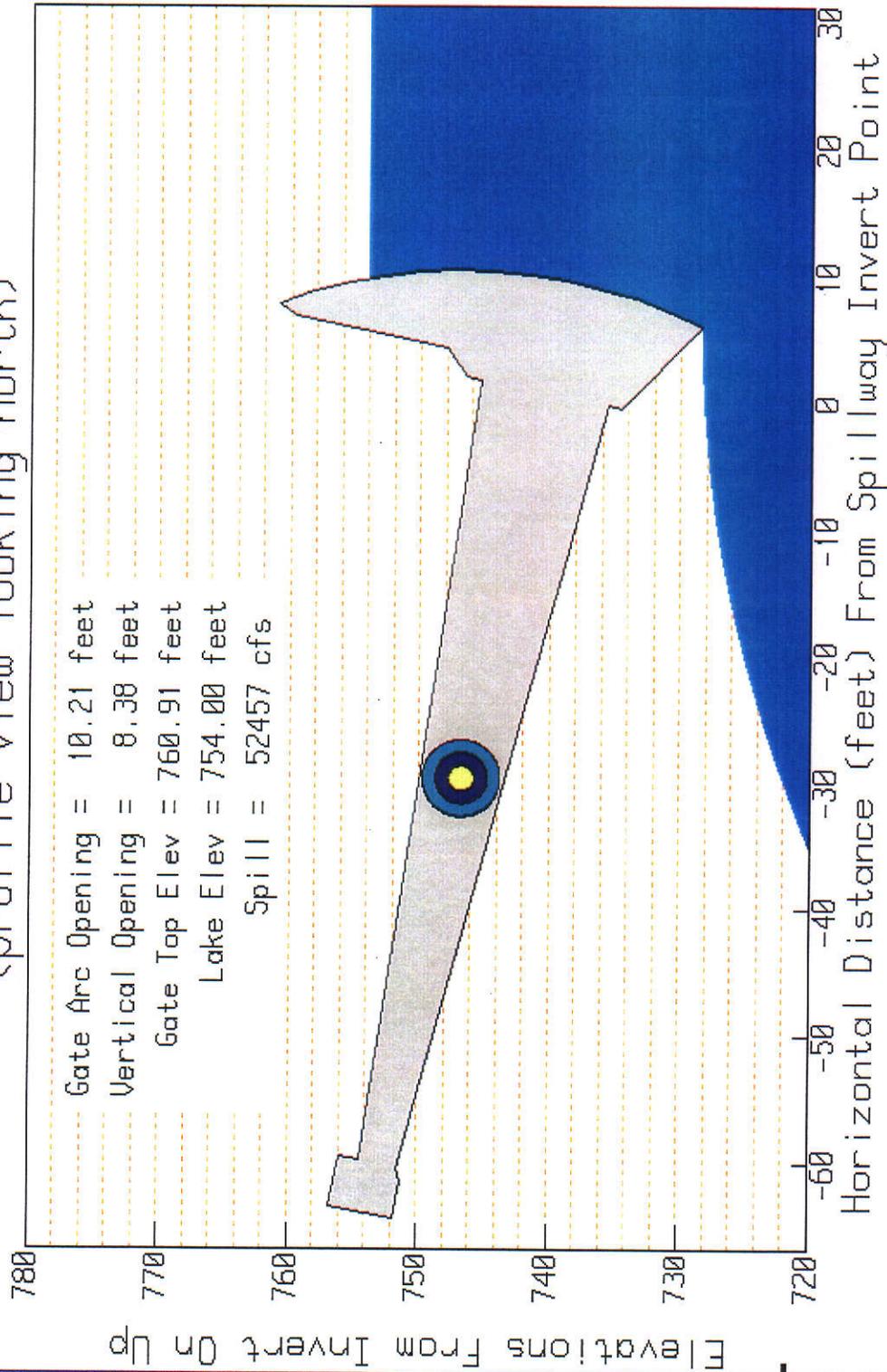
Rule Curve Example - Res El = 754

TransEra HTBasic - CAGATES

CACHUMA SPILLWAY GATE POSITIONS

(profile view looking north)

Gate Arc Opening = 10.21 feet
Vertical Opening = 8.38 feet
Gate Top Elev = 760.91 feet
Lake Elev = 754.00 feet
Spill = 52457 cfs



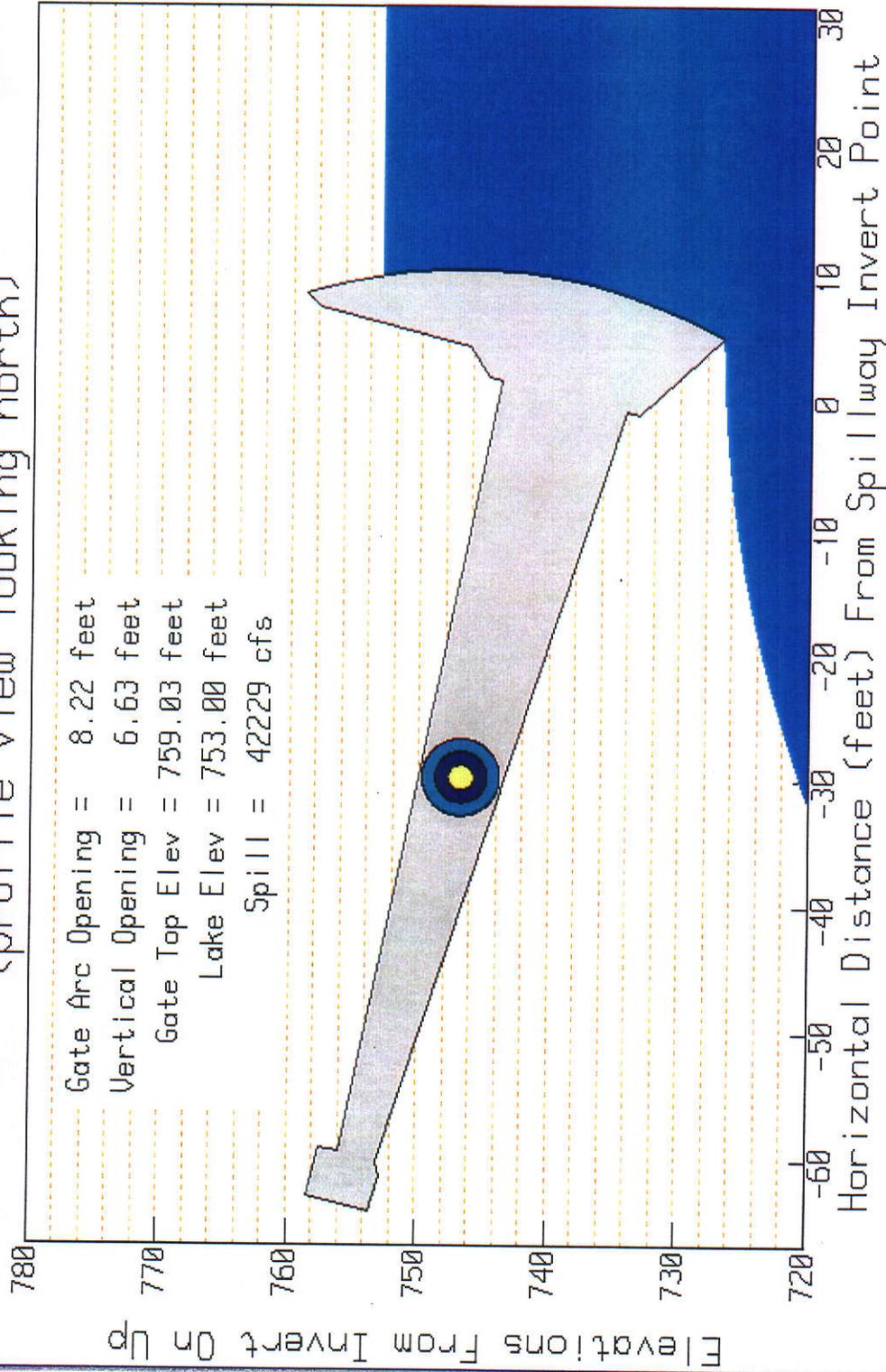
Rule Curve Example - Res El = 753

TransEra HTBasic - CAGATES

CACHUMA SPILLWAY GATE POSITIONS

(profile view looking north)

Gate Arc Opening = 8.22 feet
Vertical Opening = 6.63 feet
Gate Top Elev = 759.03 feet
Lake Elev = 753.00 feet
Spill = 42229 cfs



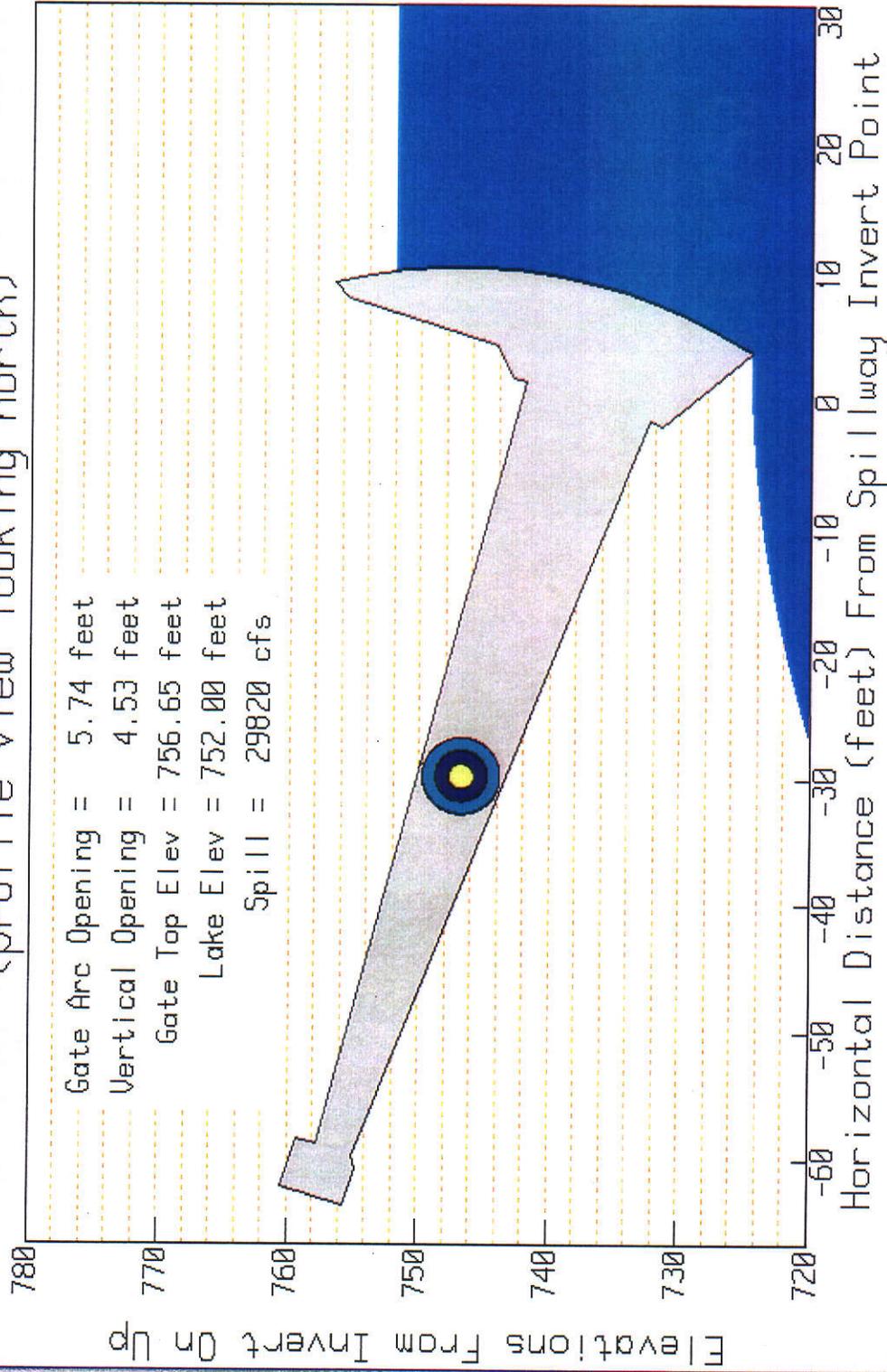
Rule Curve Example - Res El = 752

TransEra HTBasic - CAGATES

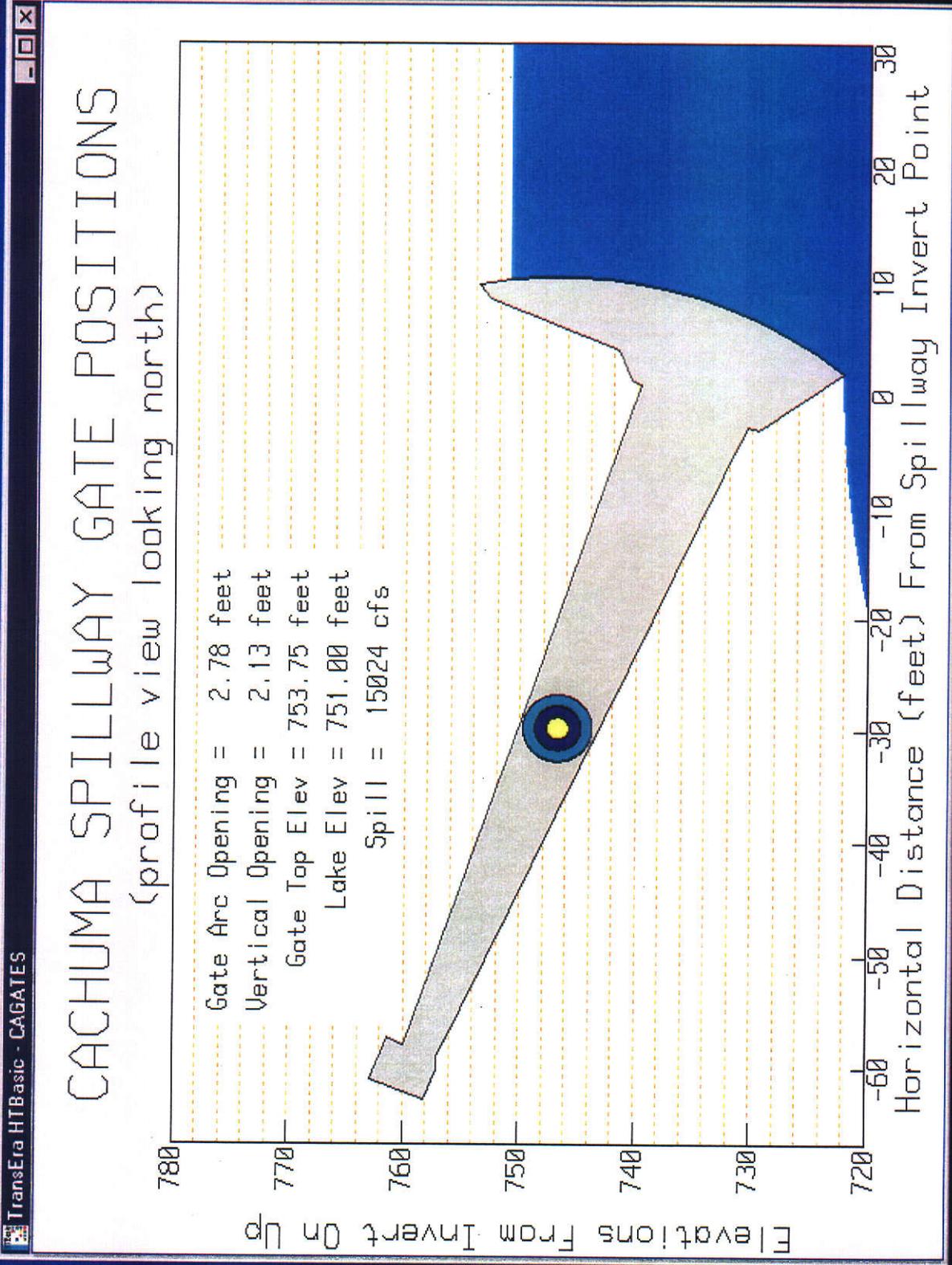
CACHUMA SPILLWAY GATE POSITIONS

(profile view looking north)

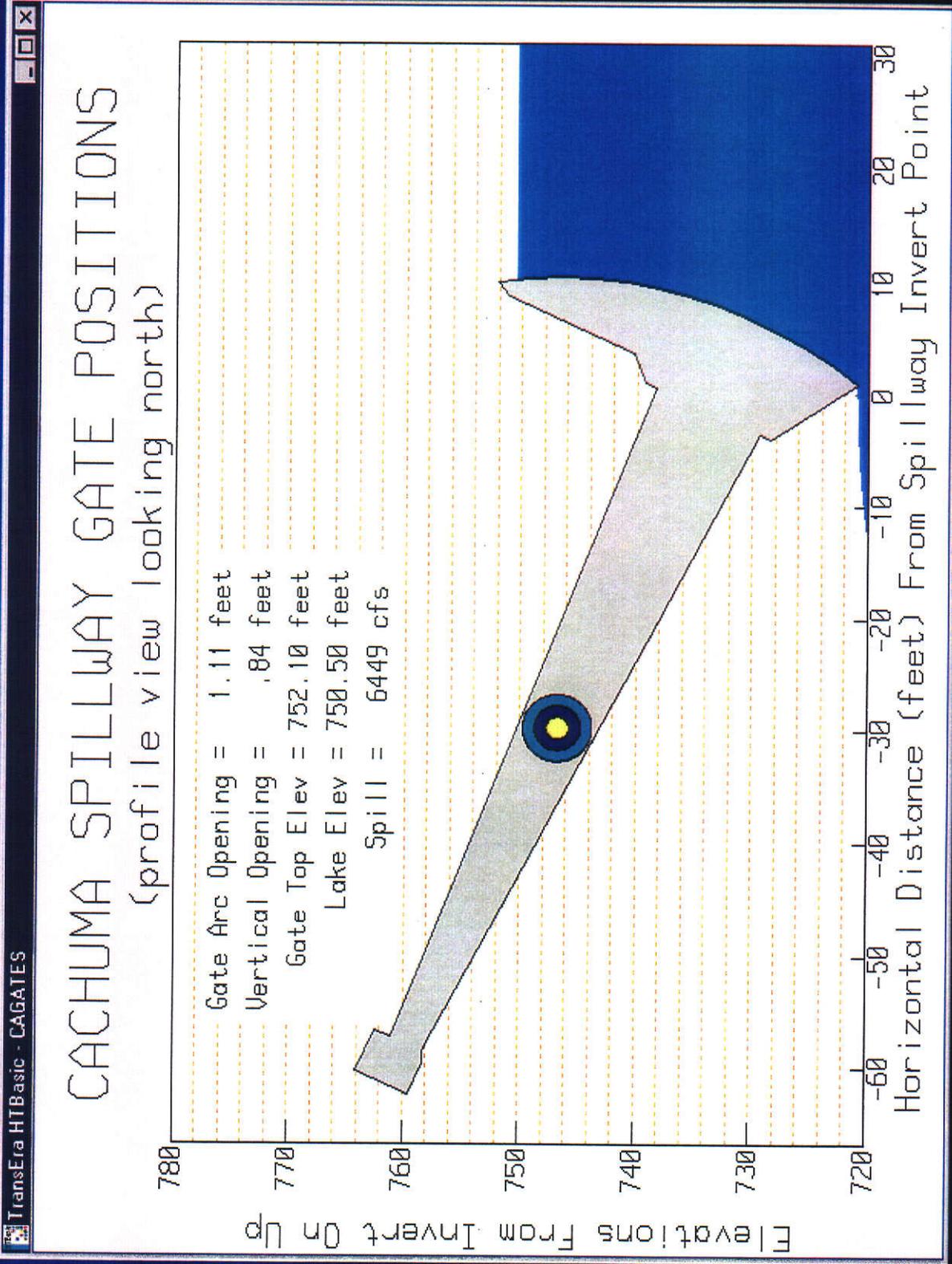
Gate Arc Opening = 5.74 feet
Vertical Opening = 4.53 feet
Gate Top Elev = 756.65 feet
Lake Elev = 752.00 feet
Spill = 29820 cfs



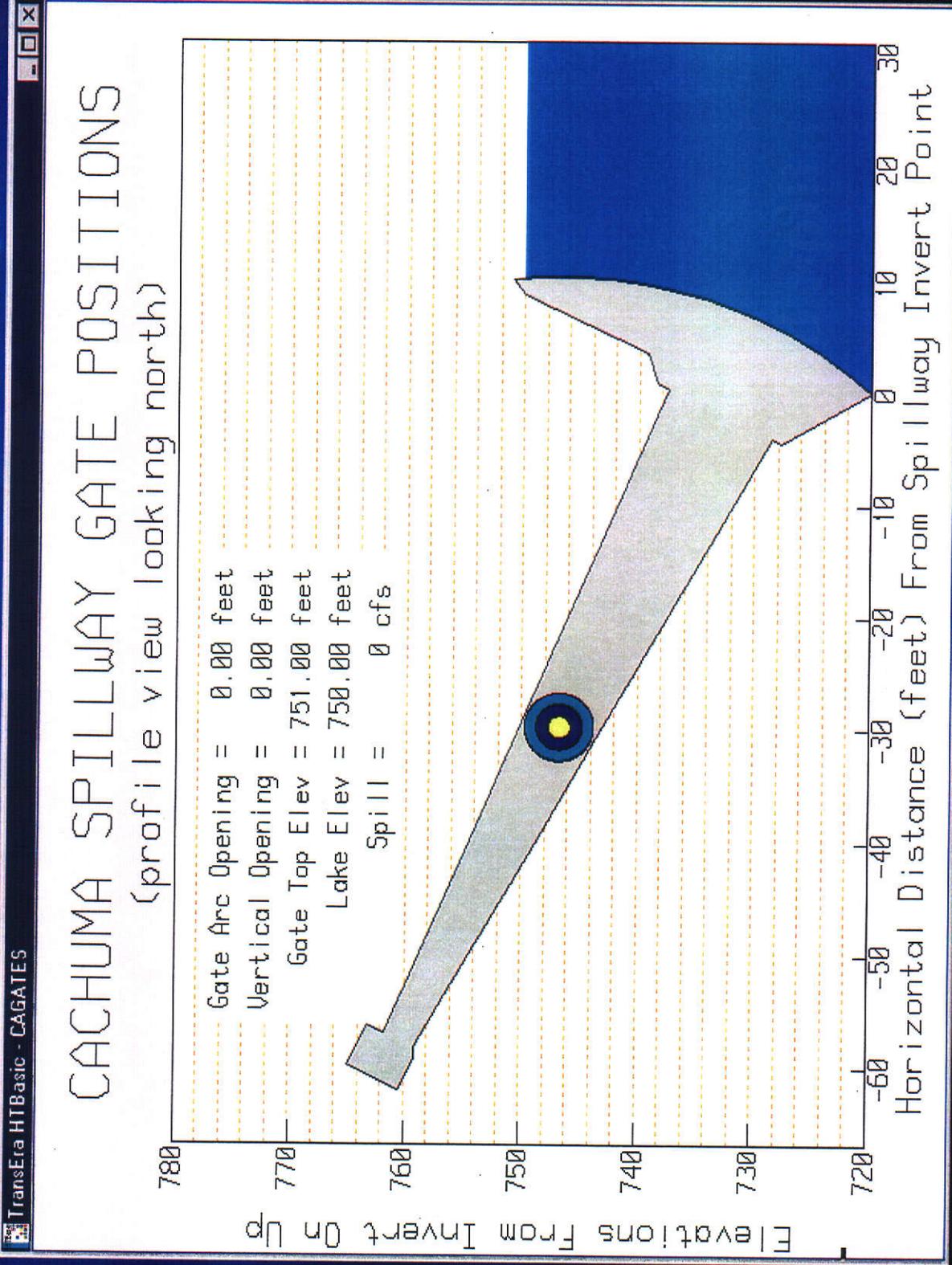
Rule Curve Example - Res El = 751



Rule Curve Example - Res El = 750.5



Rule Curve Example - End Spill



Modified Storm Operations

Gate Operations Simulation
MODIFIED STORM OPERATIONS

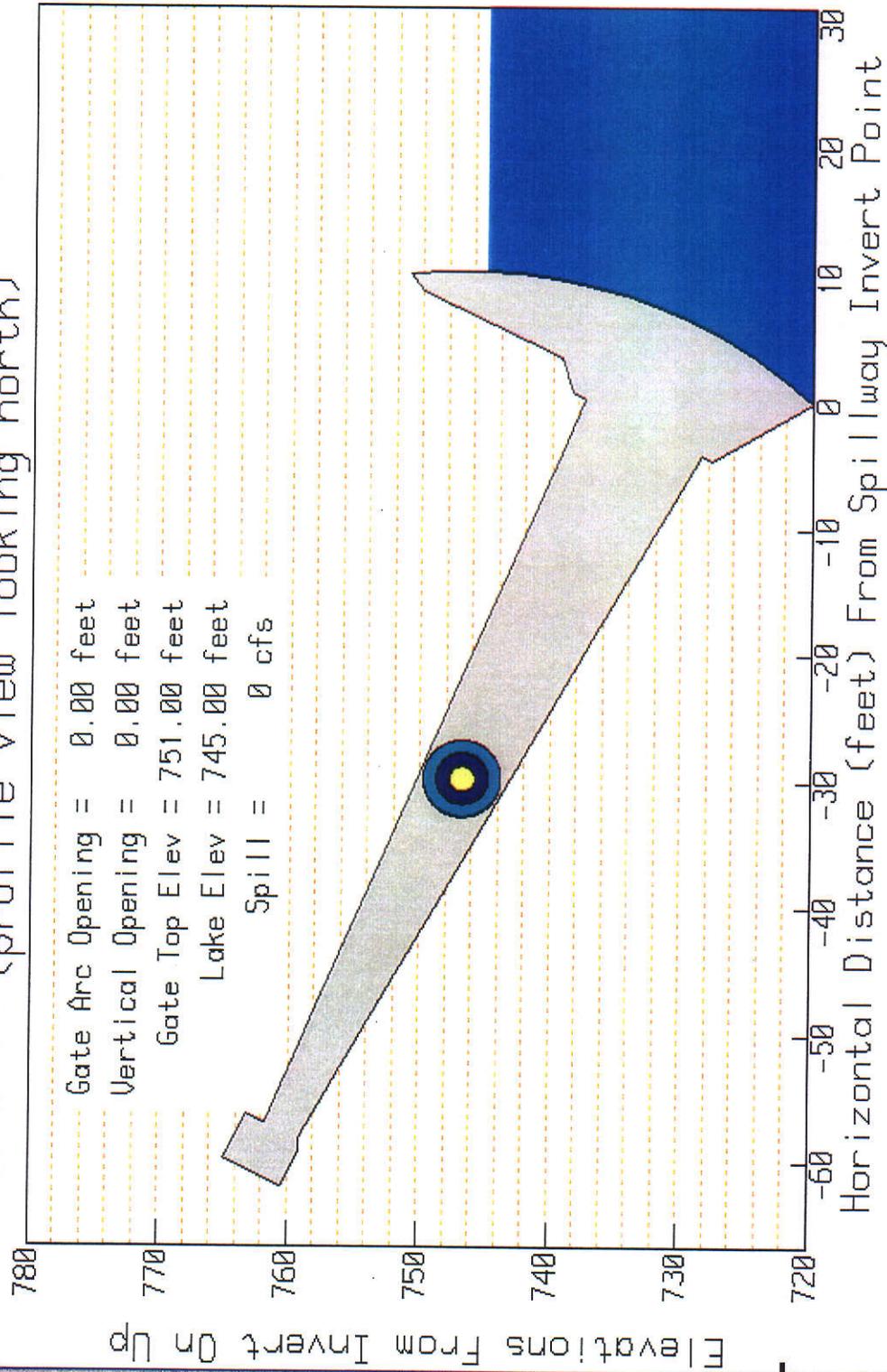
Modified Ops Example - El = 745

TransEra HTBasic - CAGATES

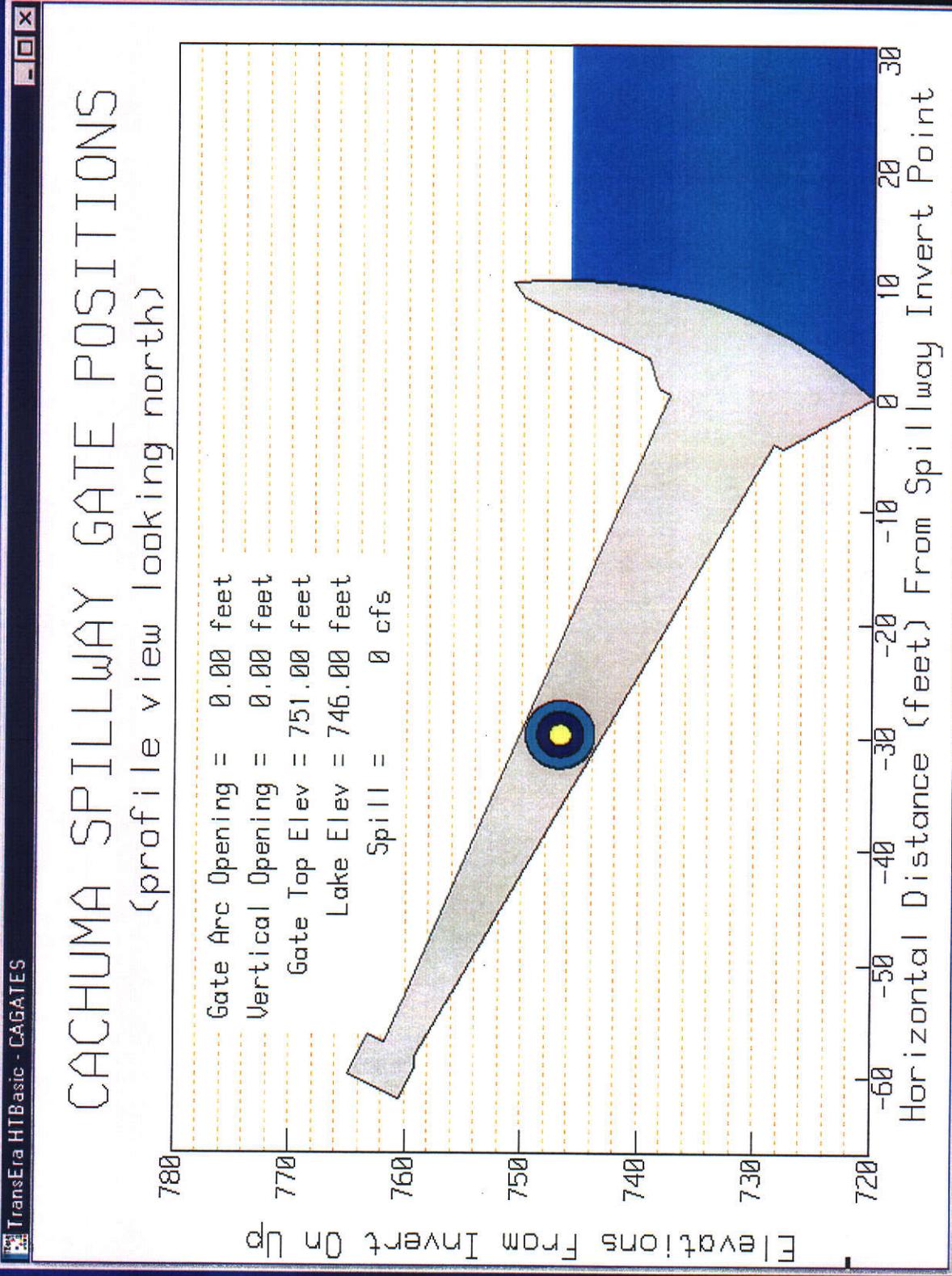
CACHUMA SPILLWAY GATE POSITIONS

(profile view looking north)

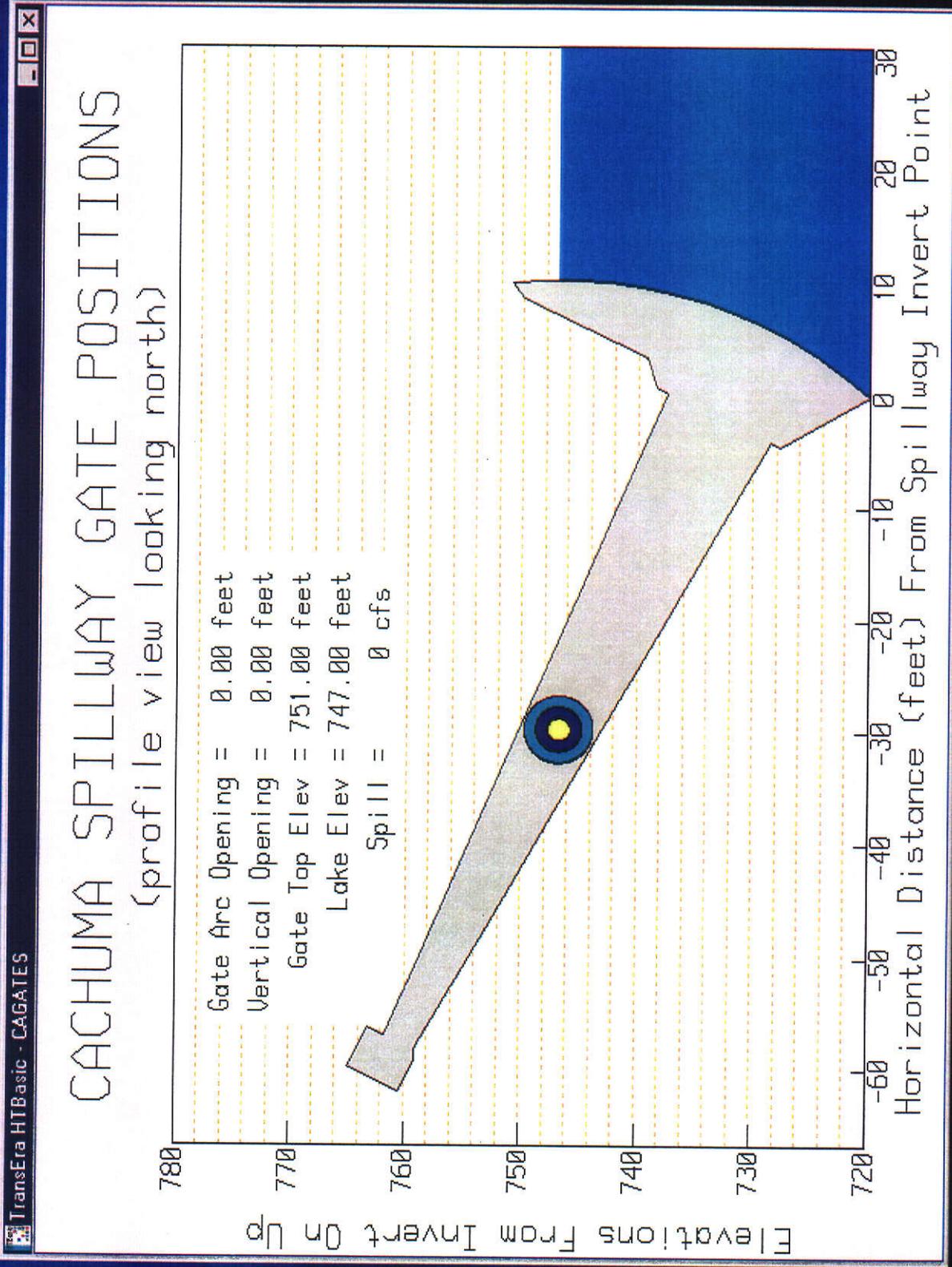
Gate Arc Opening = 0.00 feet
Vertical Opening = 0.00 feet
Gate Top Elev = 751.00 feet
Lake Elev = 745.00 feet
Spill = 0 cfs



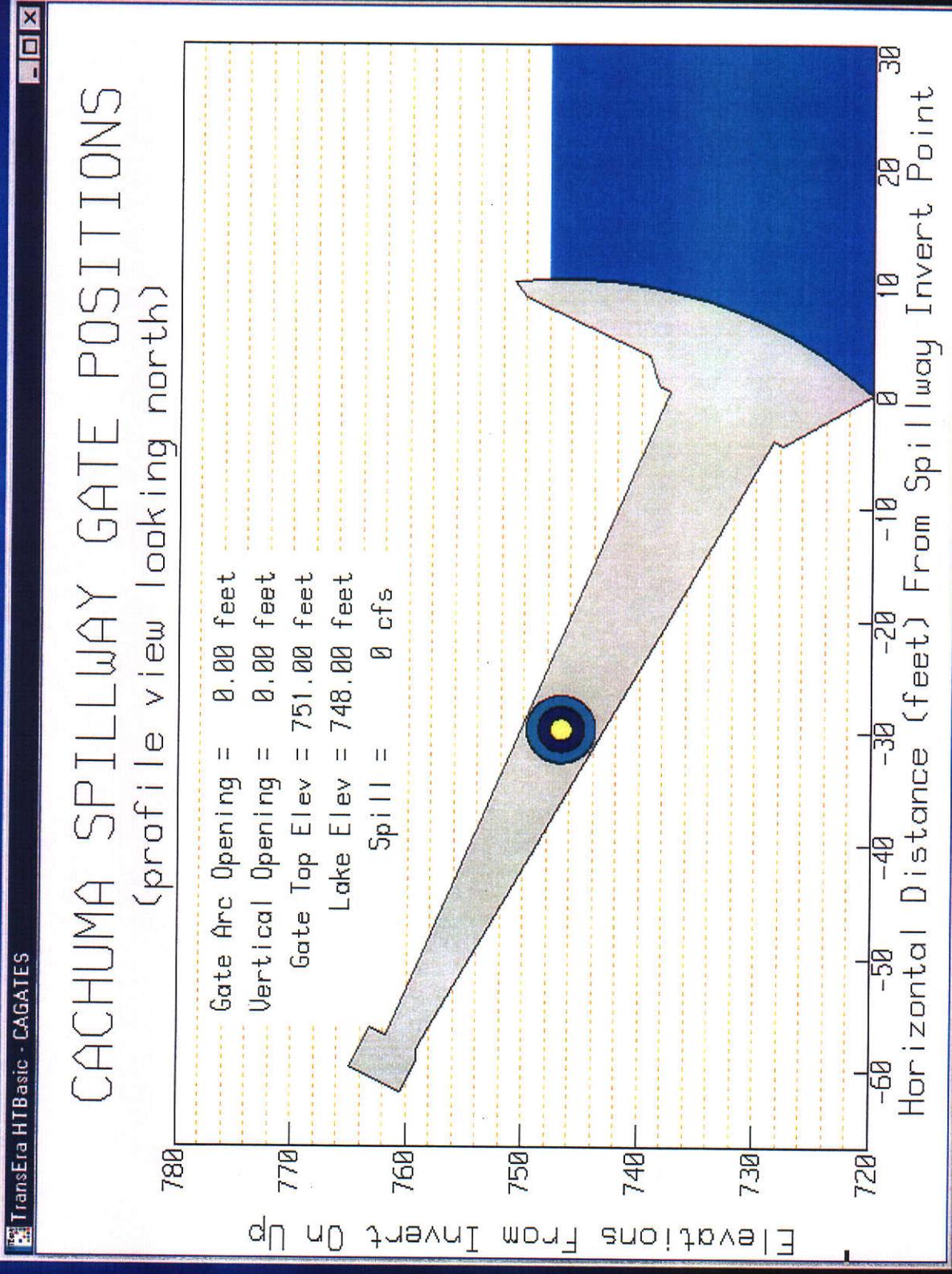
Modified Ops Example - El = 746



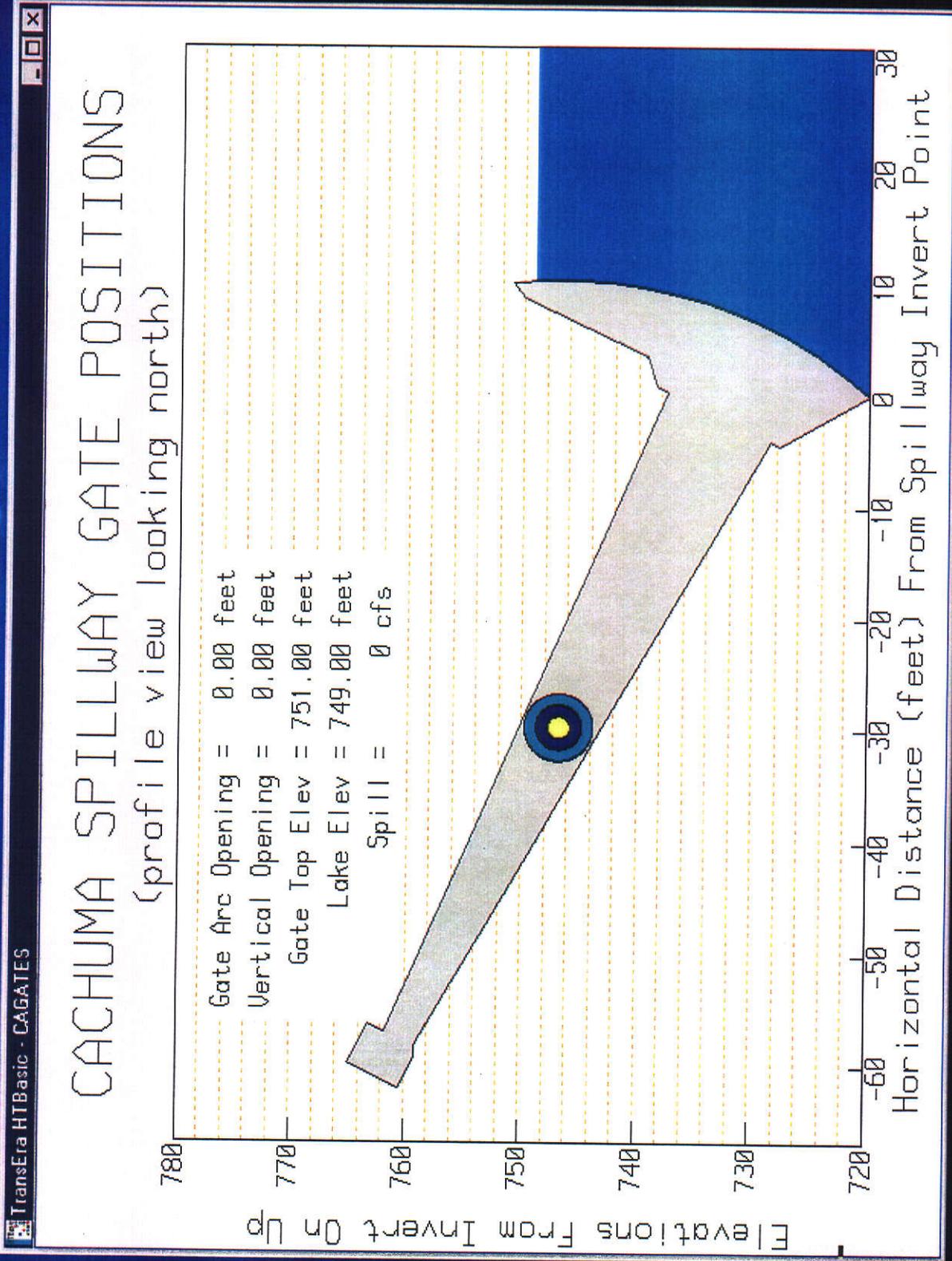
Modified Ops Example - El = 747



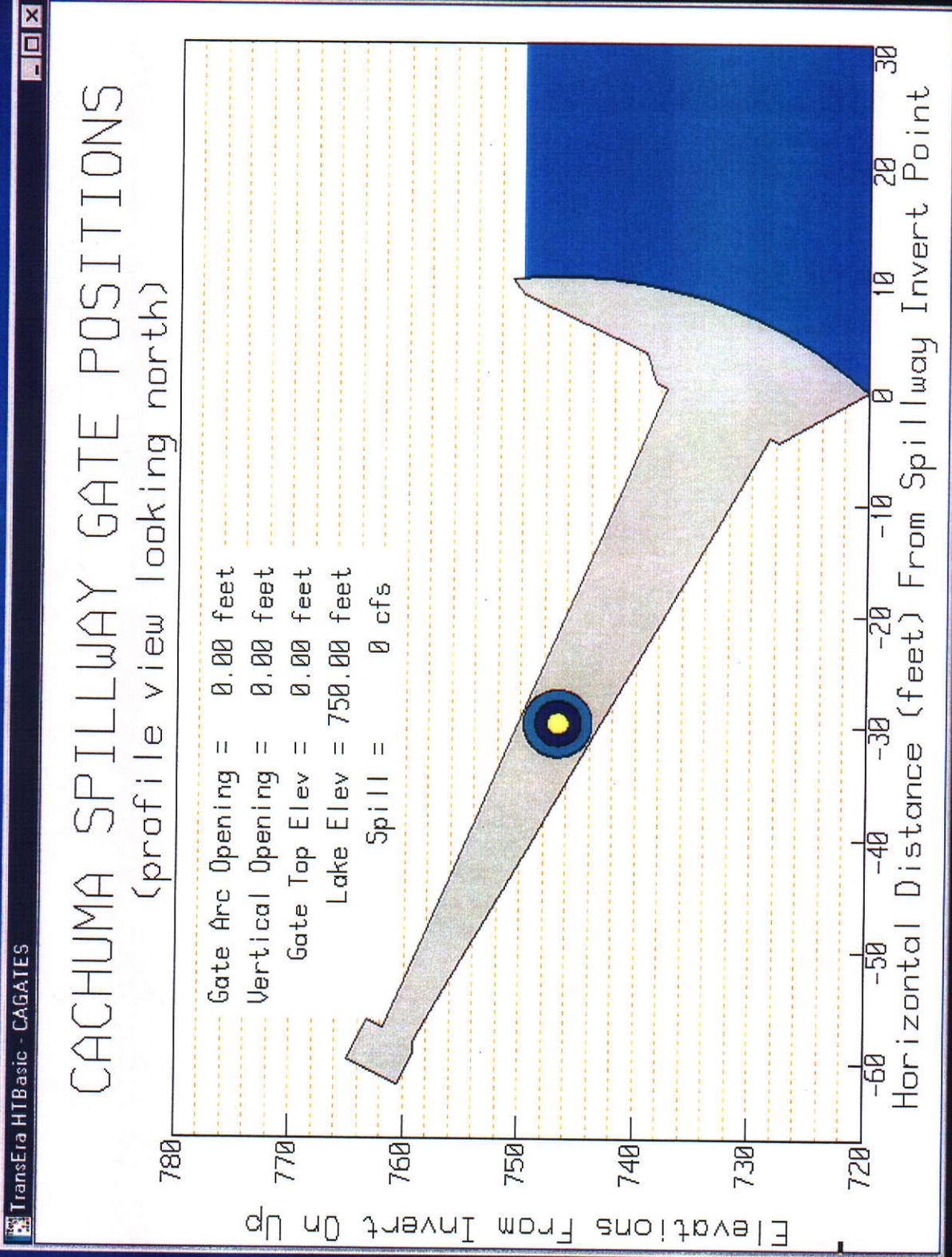
Modified Ops Example - El = 748



Modified Ops Example - El = 749



Modified Ops Example - El = 750



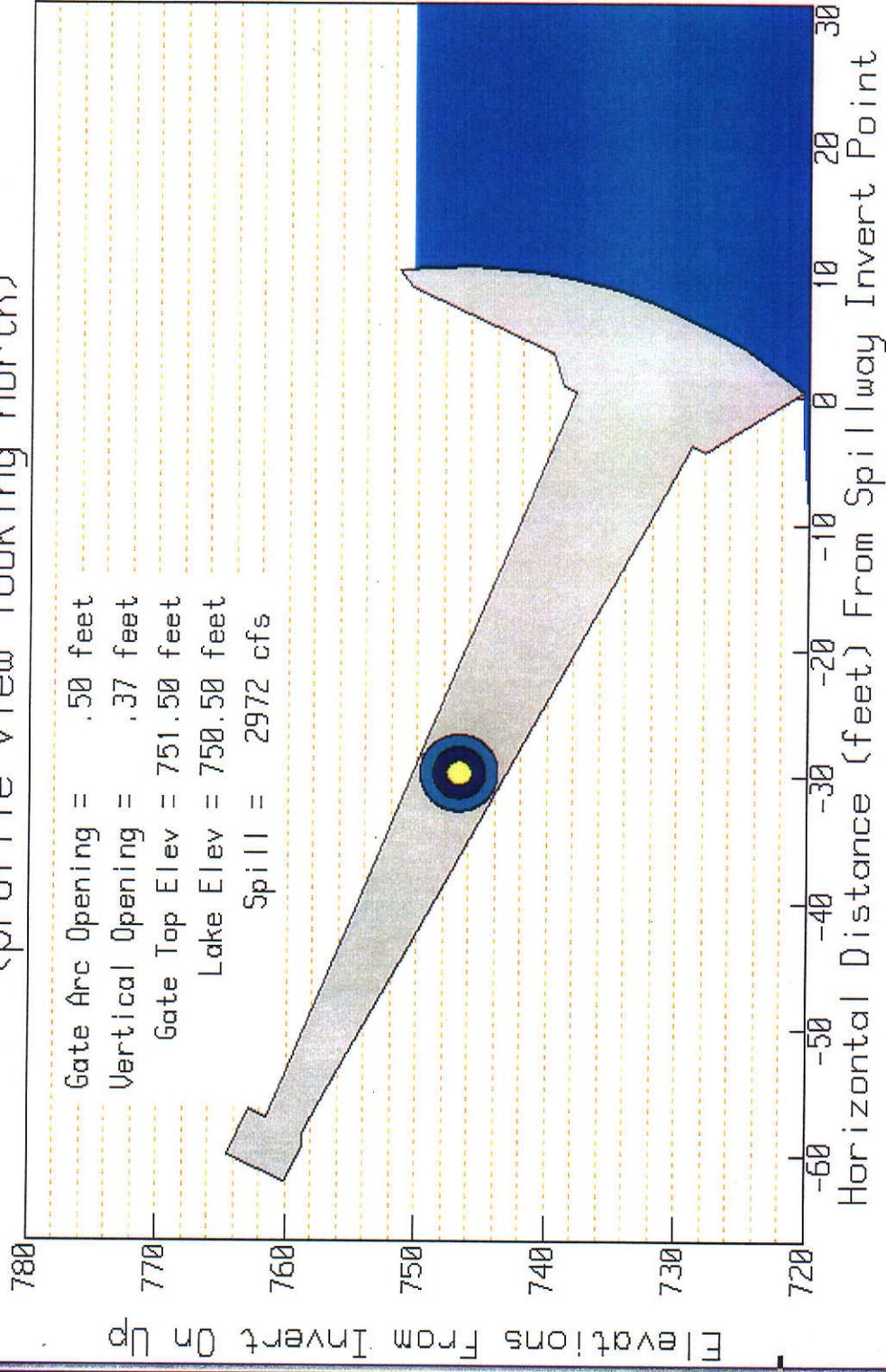
Modified Ops Example - El = 750.5

TransEra HTBasic - CAGATES

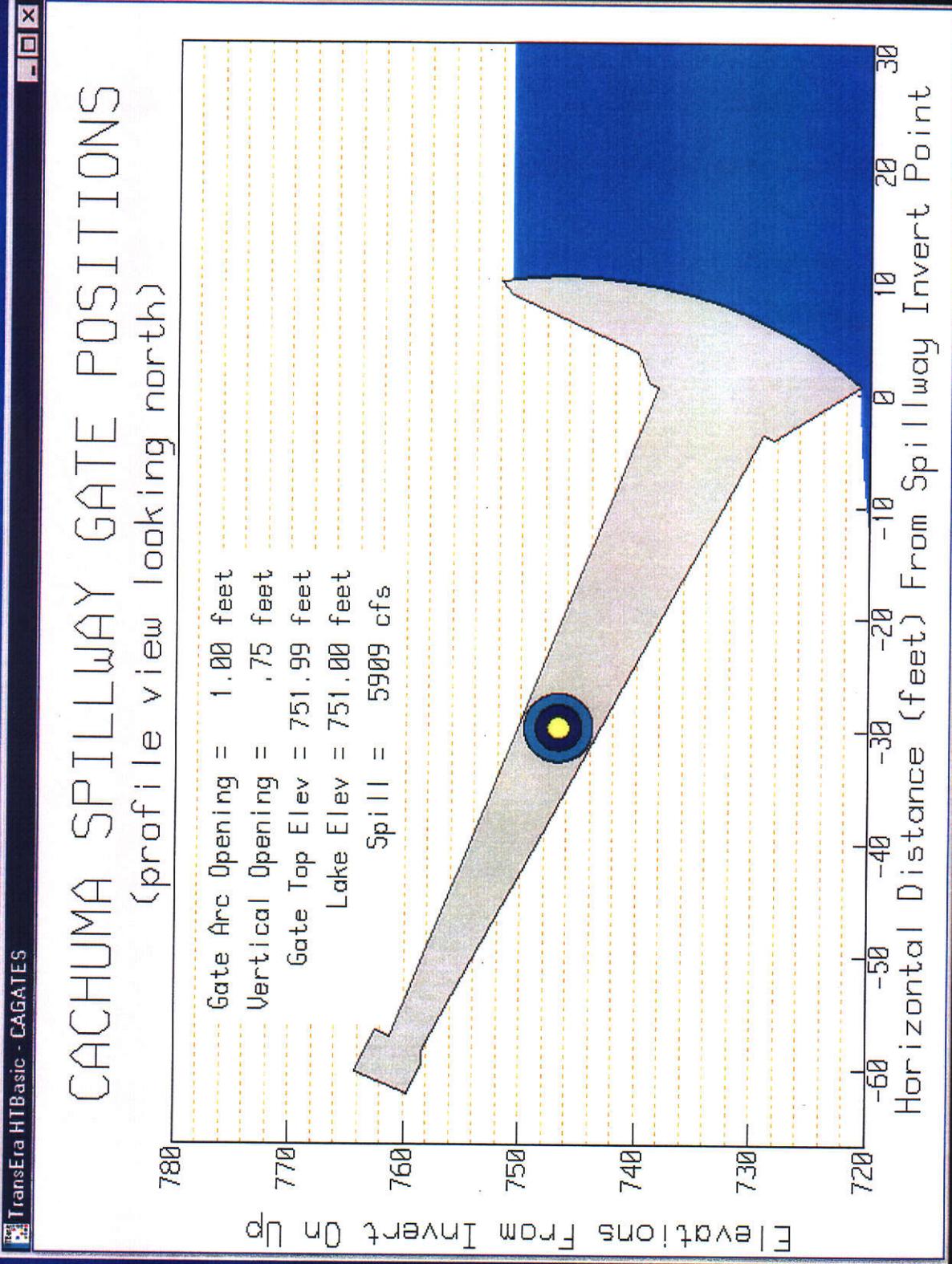
CACHUMA SPILLWAY GATE POSITIONS

(profile view looking north)

Gate Arc Opening = .50 feet
Vertical Opening = .37 feet
Gate Top Elev = 751.50 feet
Lake Elev = 750.50 feet
Spill = 2972 cfs



Modified Ops Example - El = 751



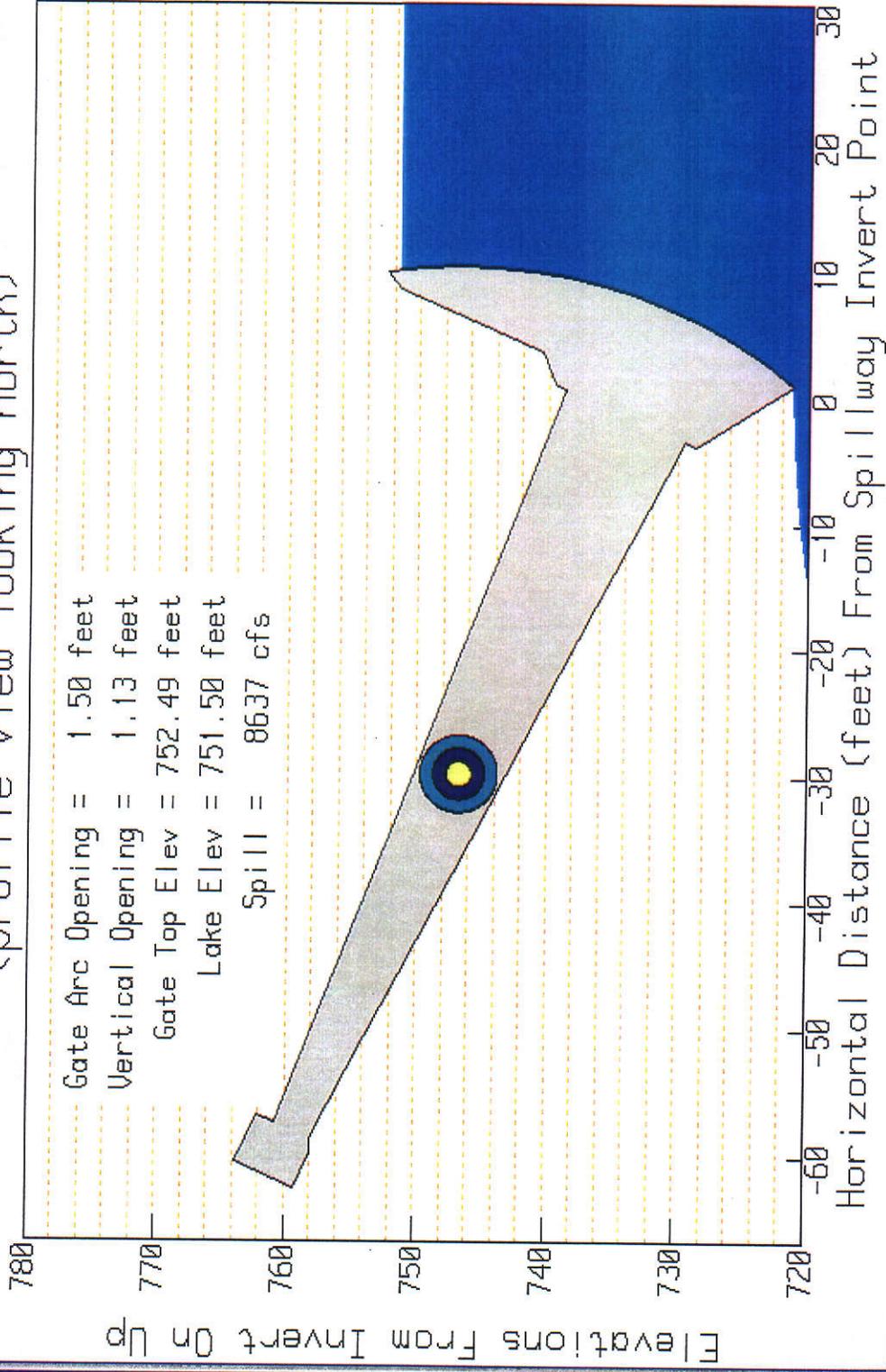
Modified Ops Example - El = 751.5

TransEra HTBasic - CAGATES

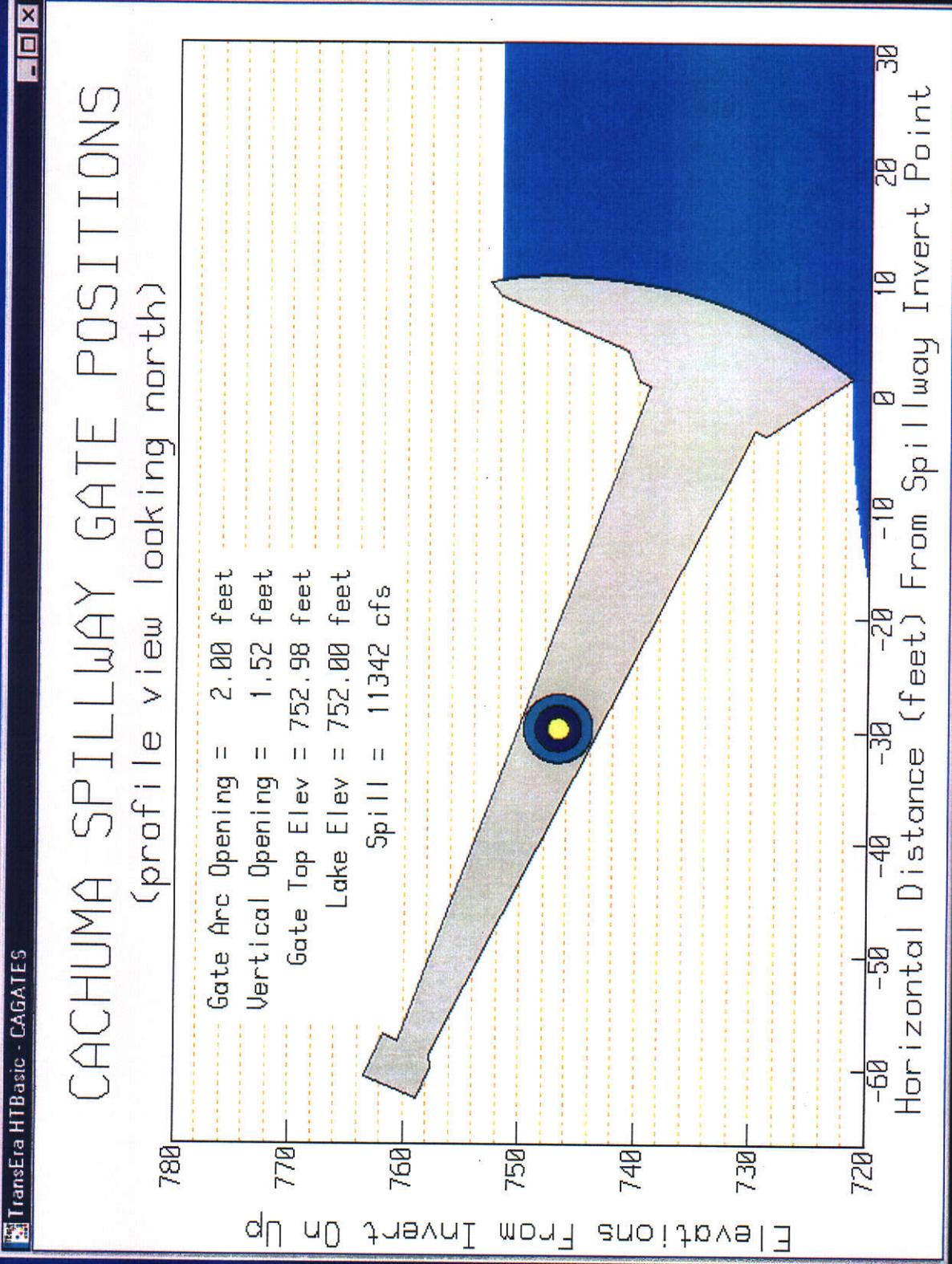
CACHUMA SPILLWAY GATE POSITIONS

(profile view looking north)

Gate Arc Opening = 1.50 feet
Vertical Opening = 1.13 feet
Gate Top Elev = 752.49 feet
Lake Elev = 751.50 feet
Spill = 8637 cfs



Modified Ops Example - EI = 752



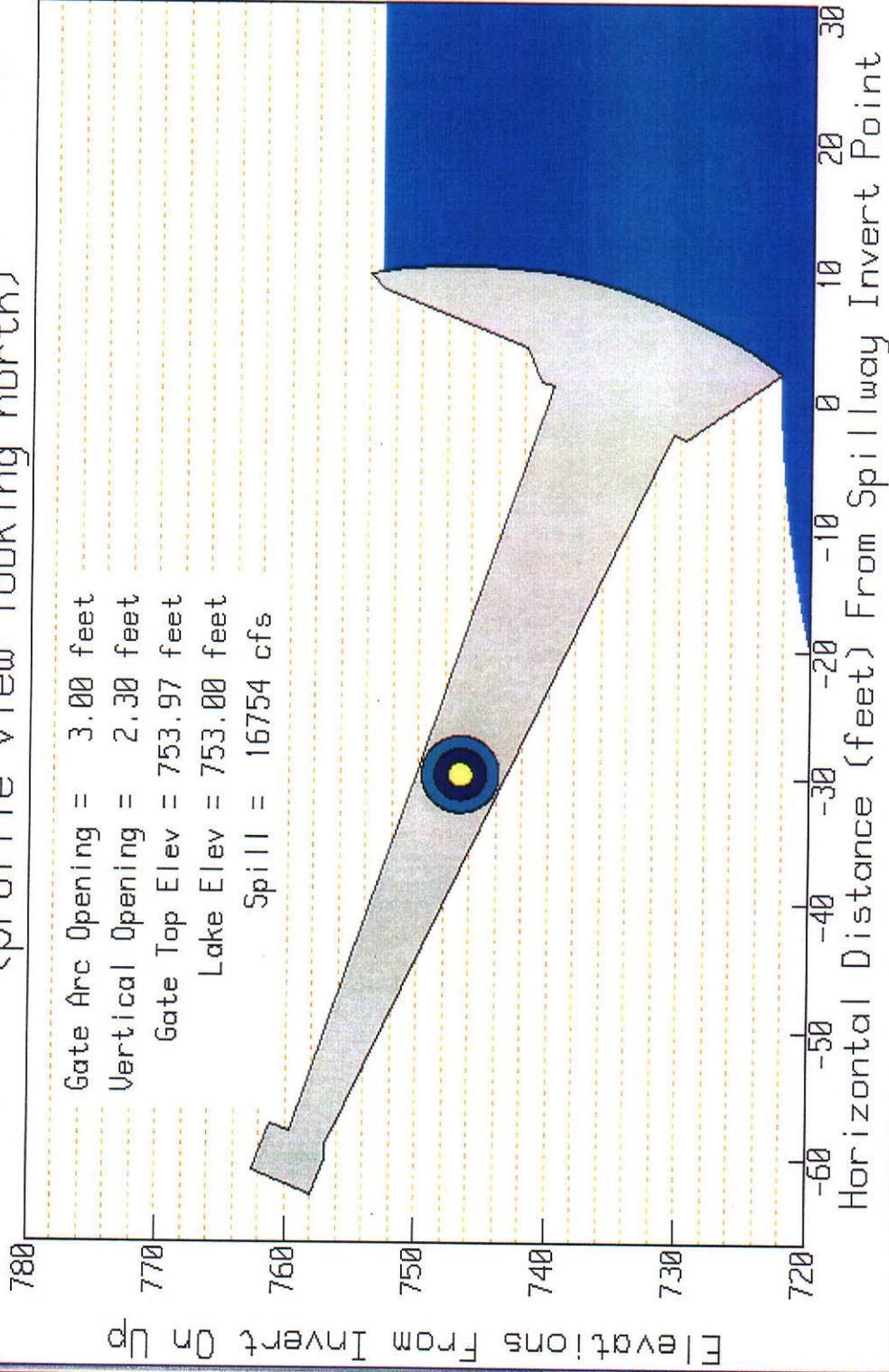
Modified Ops Example - El = 753

TransEra HTBasic - CAGATES

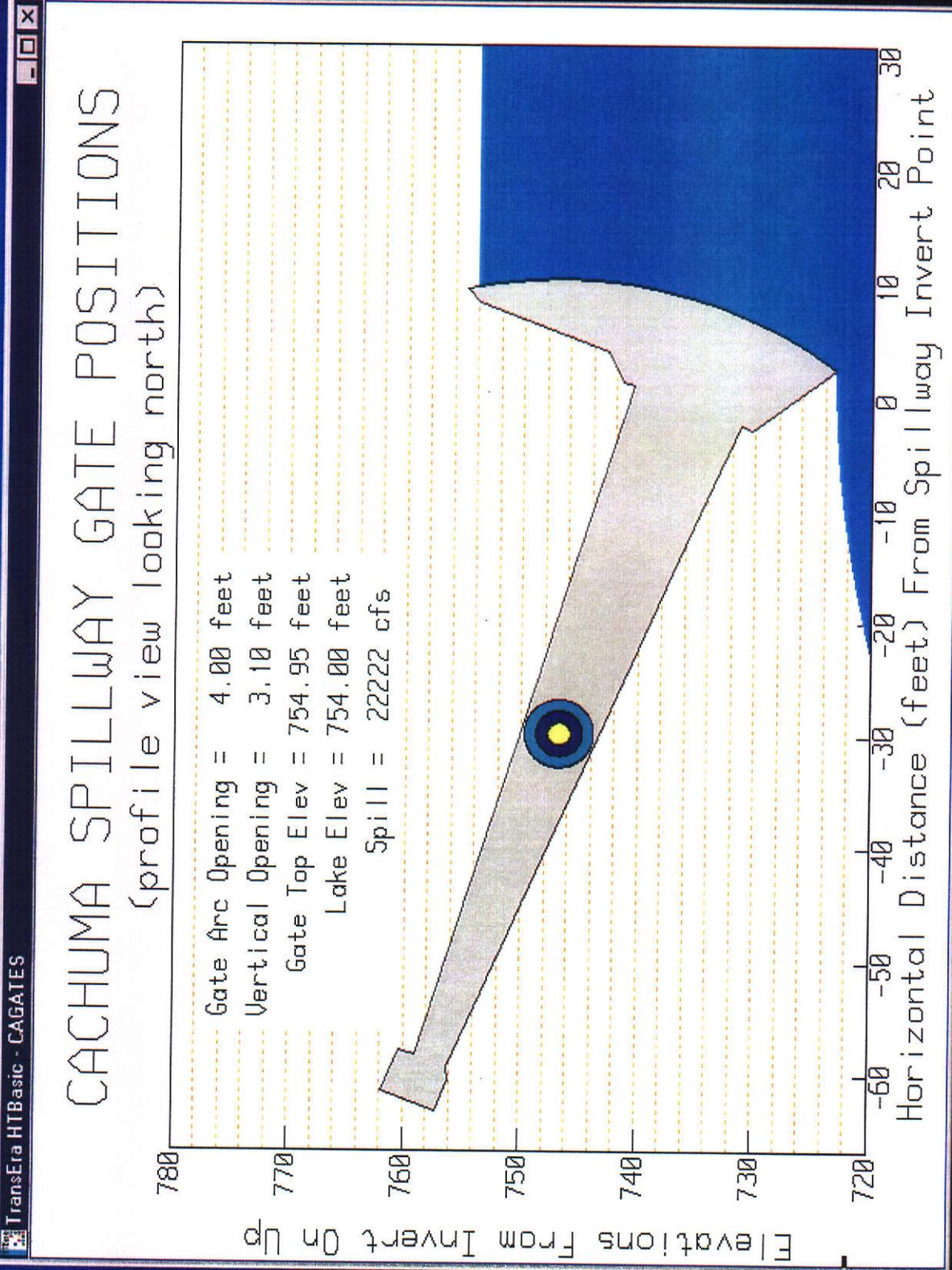
CACHUMA SPILLWAY GATE POSITIONS

(profile view looking north)

Gate Arc Opening = 3.00 feet
Vertical Opening = 2.30 feet
Gate Top Elev = 753.97 feet
Lake Elev = 753.00 feet
Spill = 16754 cfs



Modified Ops Example - El = 754



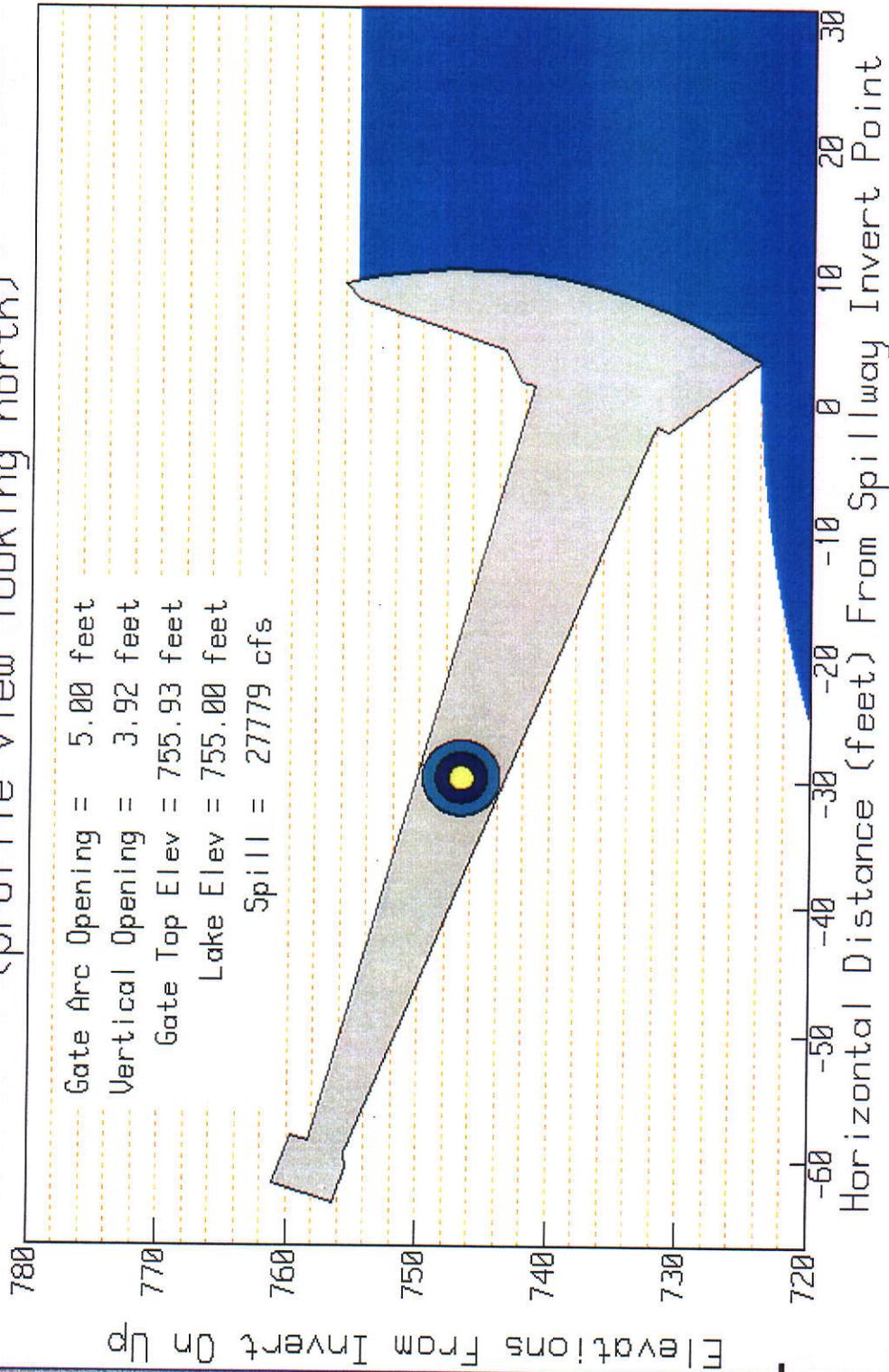
Modified Ops Example - El = 755

TransEra HTBasic - CAGATES

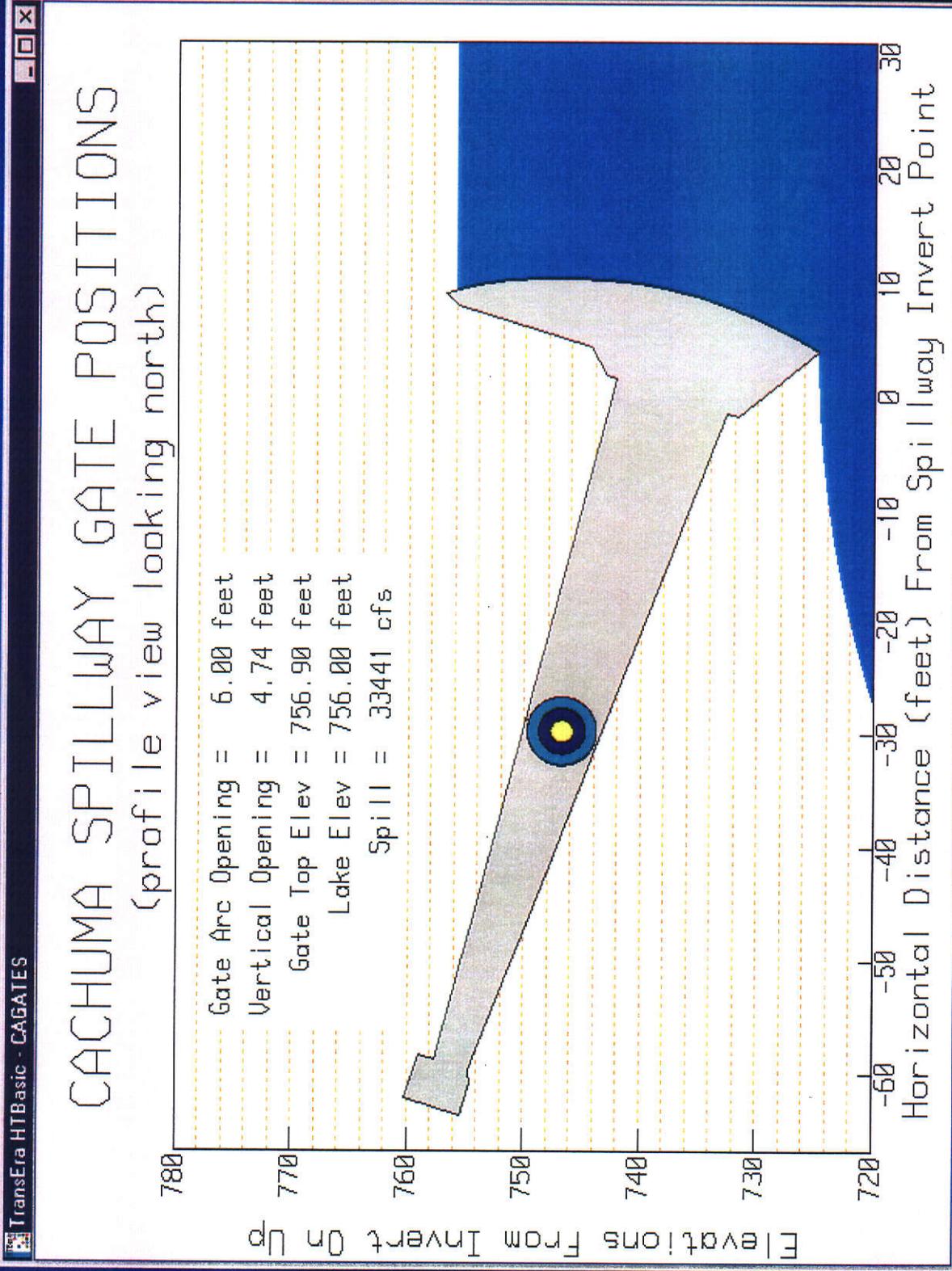
CACHUMA SPILLWAY GATE POSITIONS

(profile view looking north)

Gate Arc Opening = 5.00 feet
Vertical Opening = 3.92 feet
Gate Top Elev = 755.93 feet
Lake Elev = 755.00 feet
Spill = 27779 cfs



Modified Ops Example - El = 756



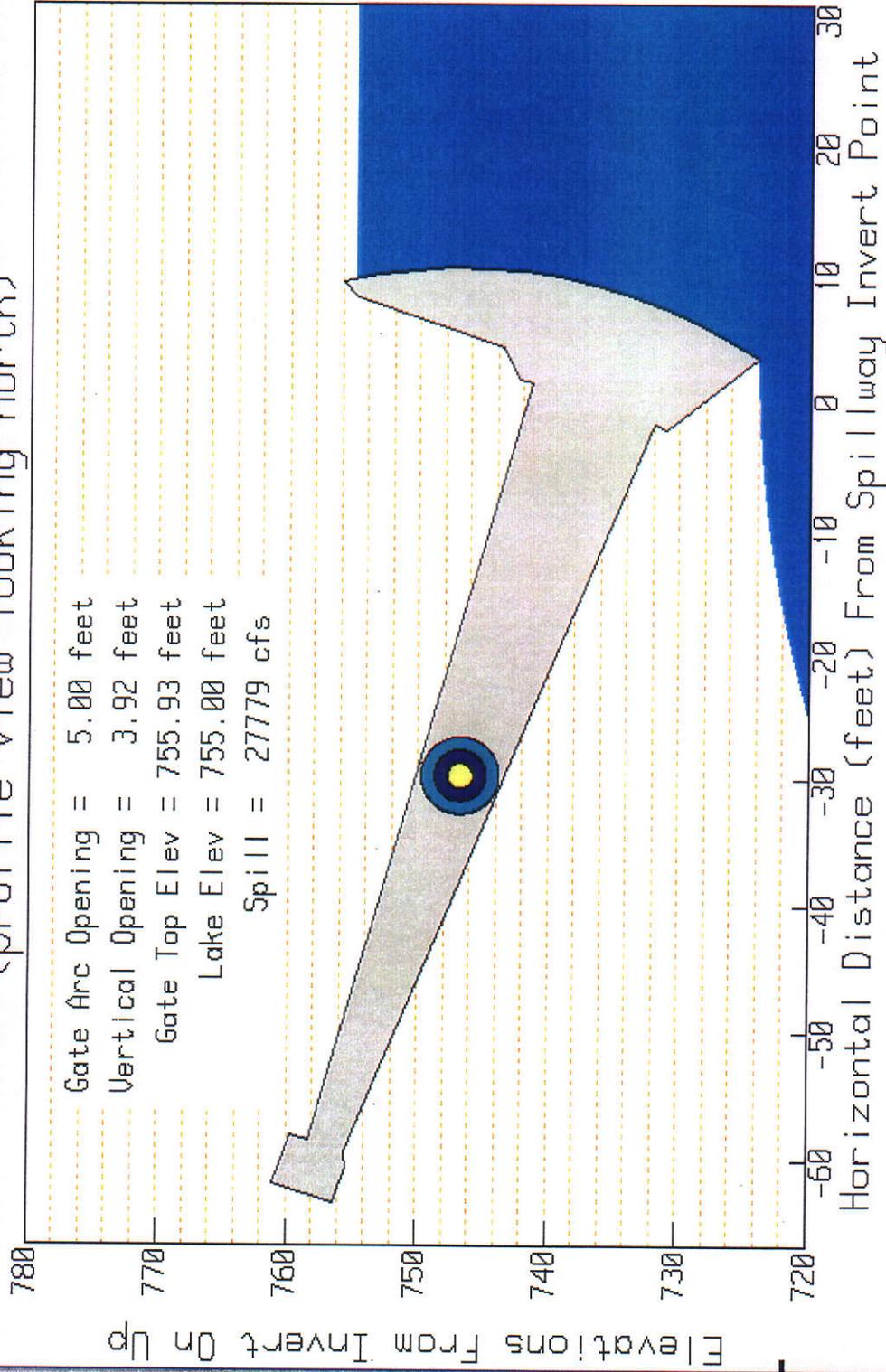
Modified Ops Example - EI = 755

TransEra HTBasic - CAGATES

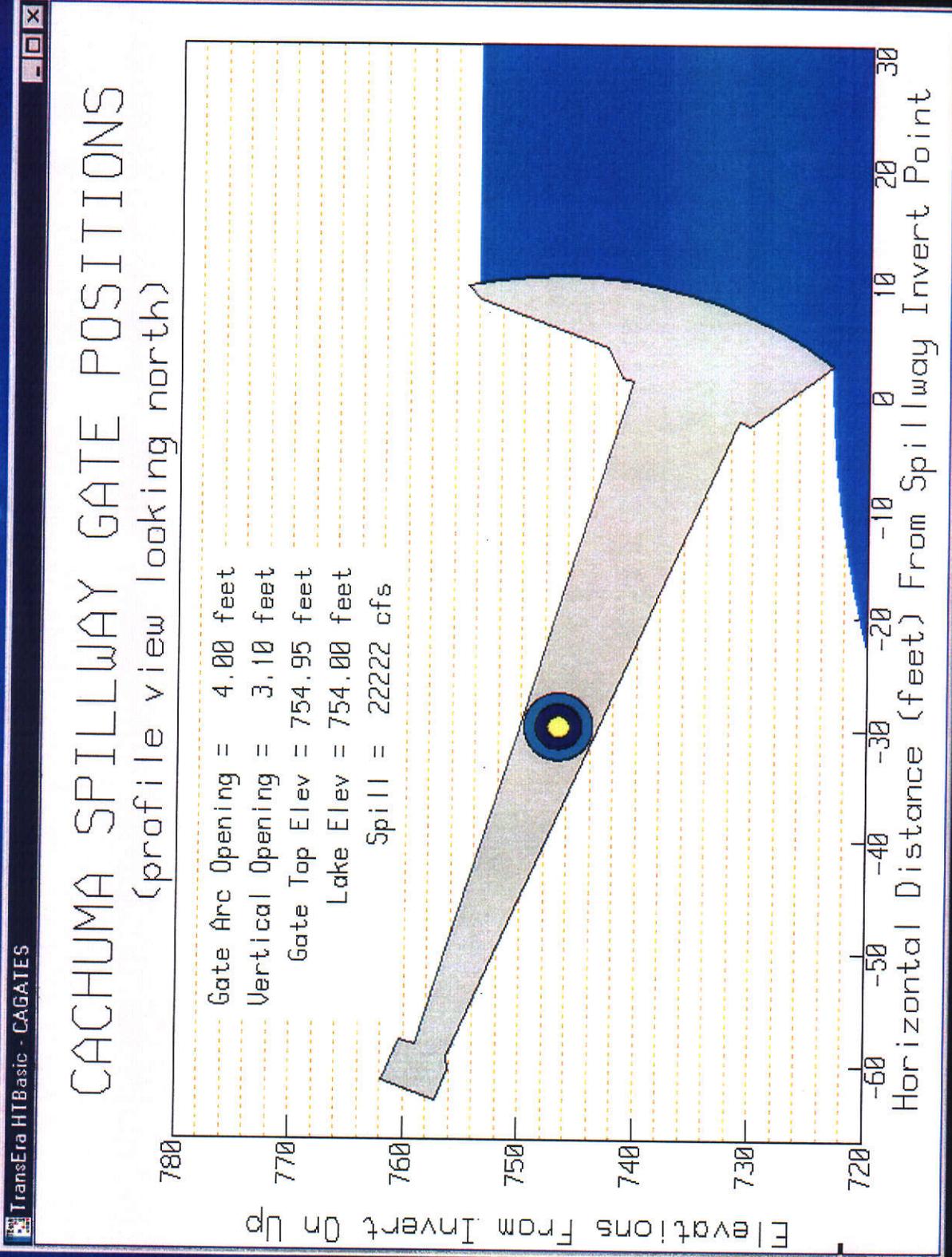
CACHUMA SPILLWAY GATE POSITIONS

(profile view looking north)

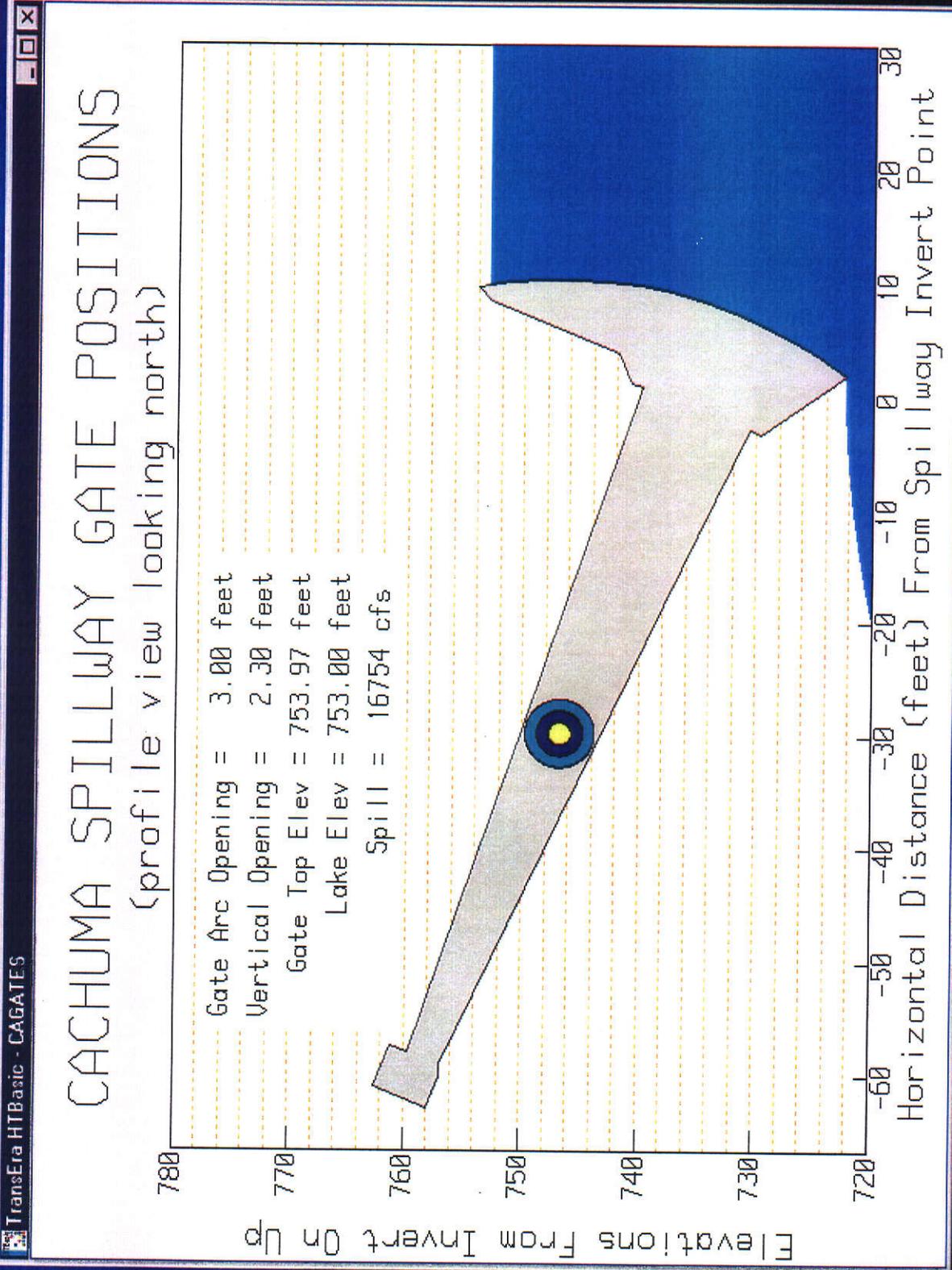
Gate Arc Opening = 5.00 feet
Vertical Opening = 3.92 feet
Gate Top Elev = 755.93 feet
Lake Elev = 755.00 feet
Spill = 27779 cfs



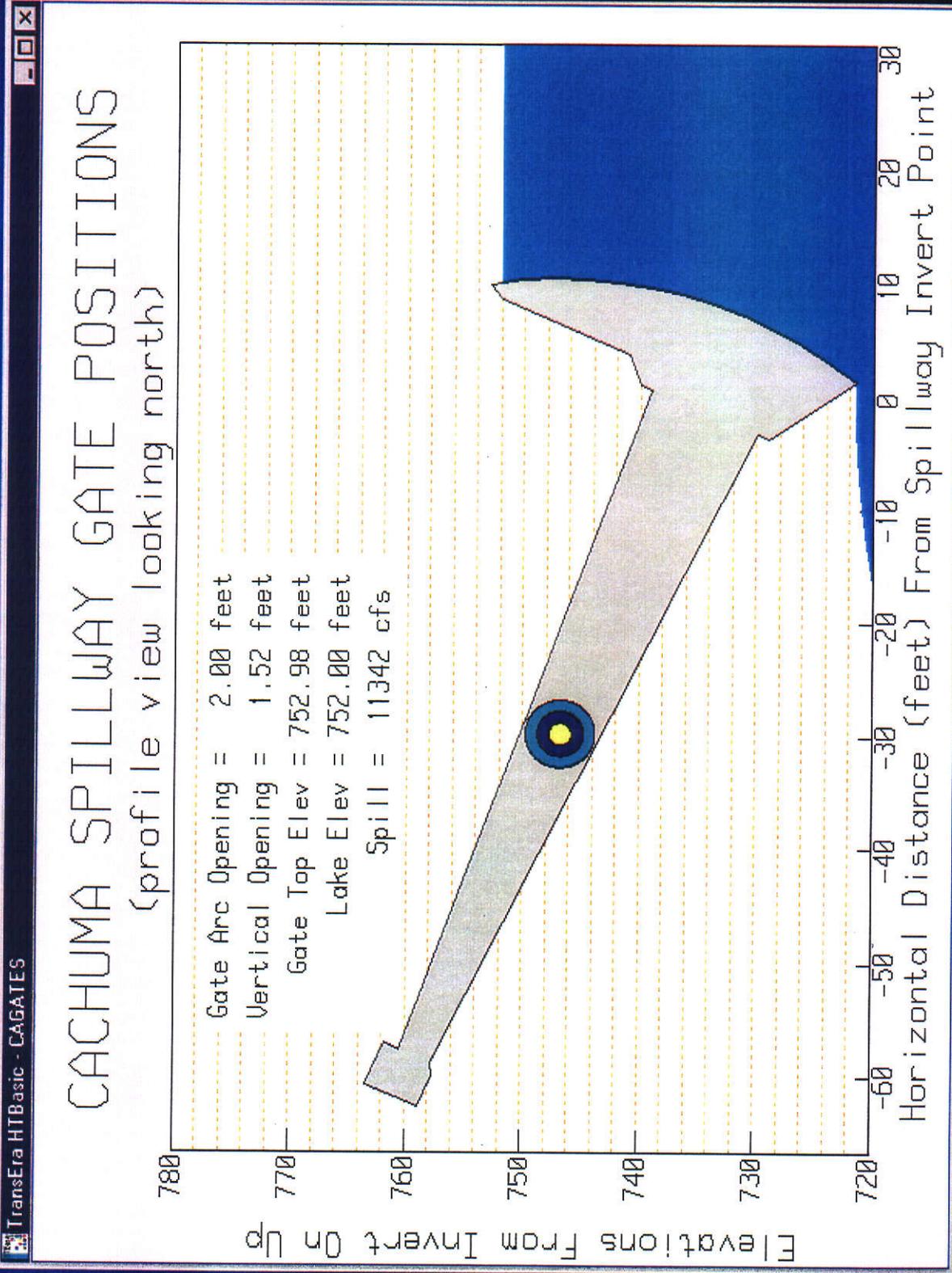
Modified Ops Example - El = 754



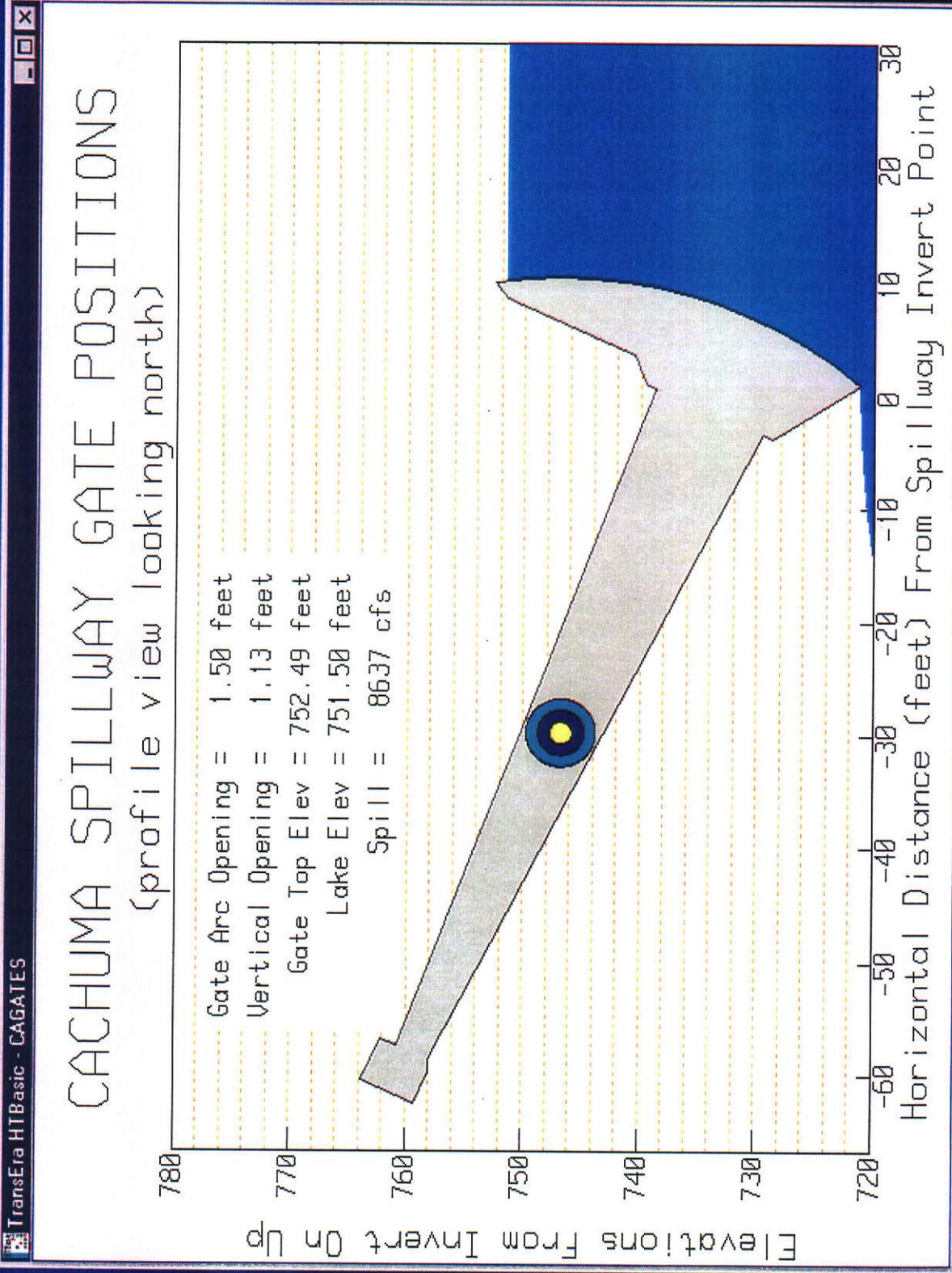
Modified Ops Example - El = 753



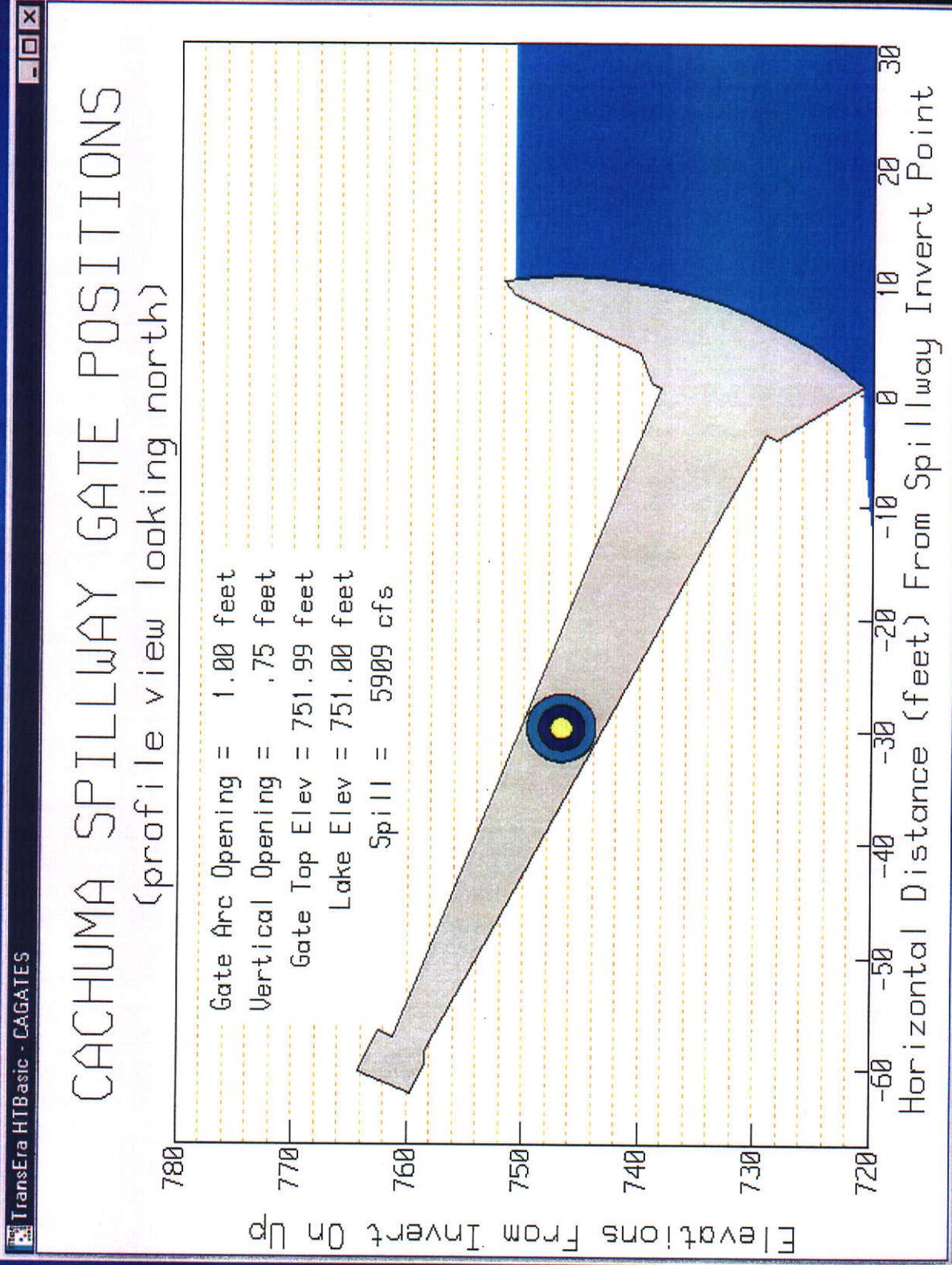
Modified Ops Example - El = 752



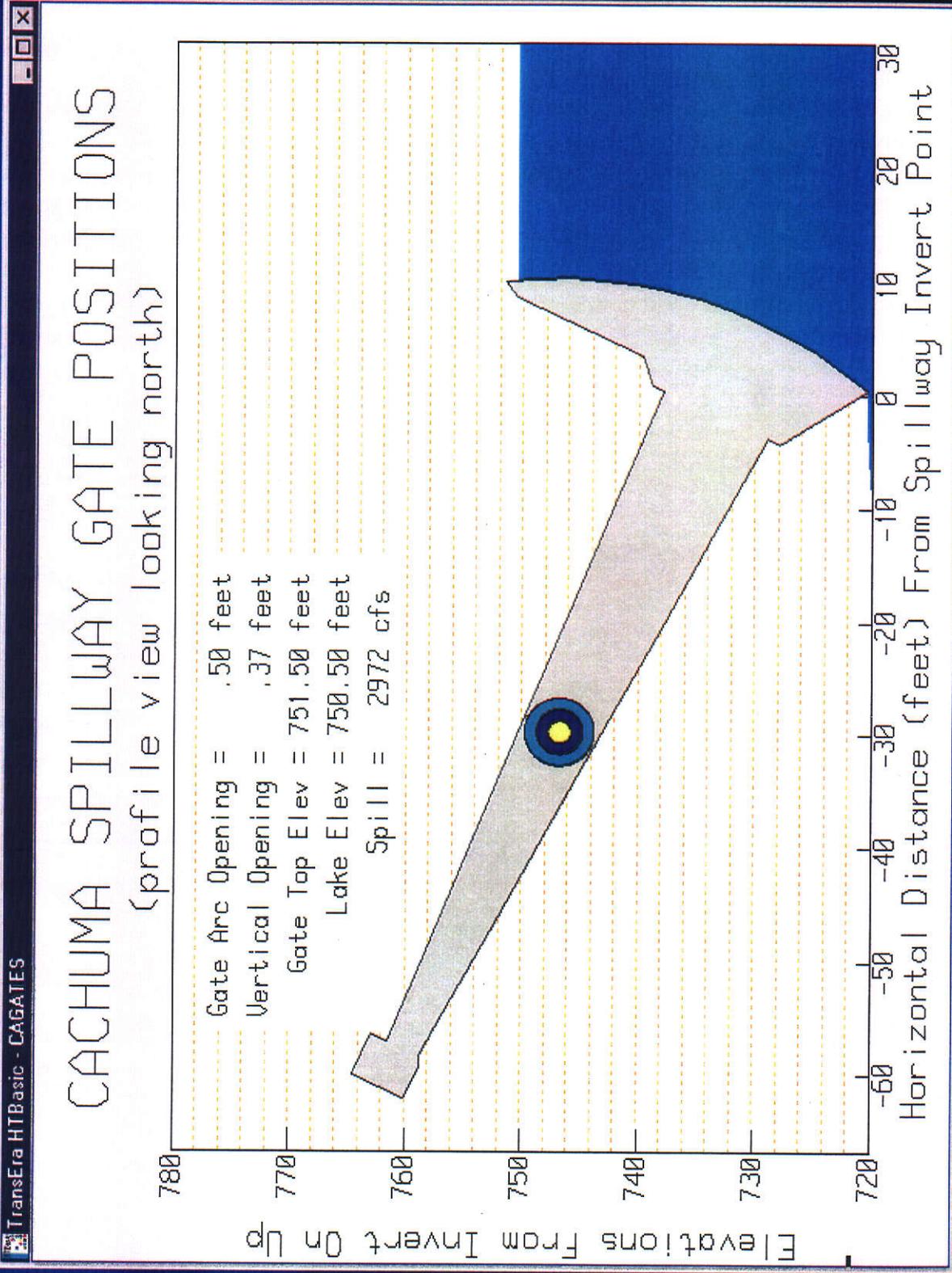
Modified Ops Example - El = 751.5



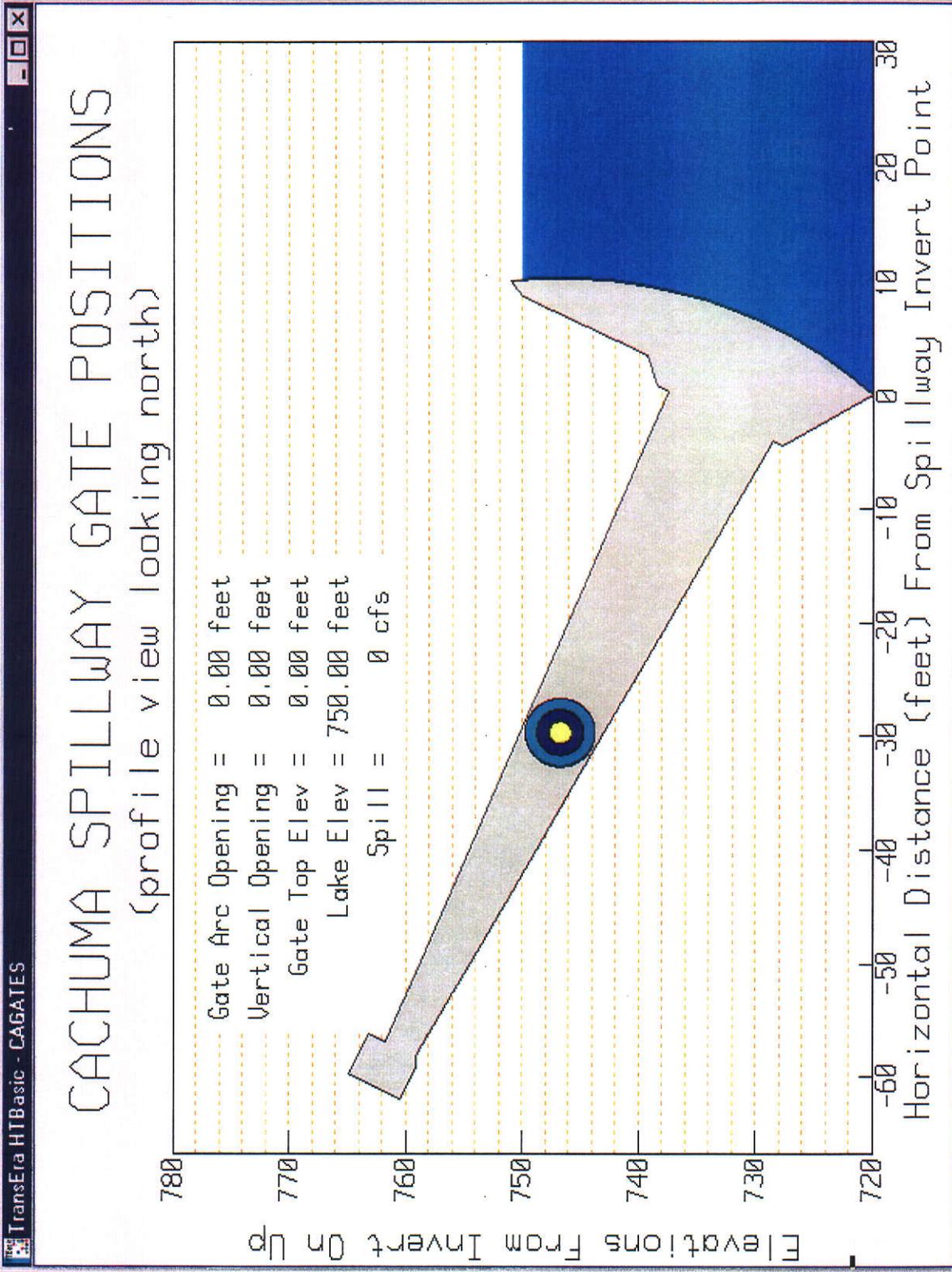
Modified Ops Example - El = 751



Modified Ops Example - El = 750.5

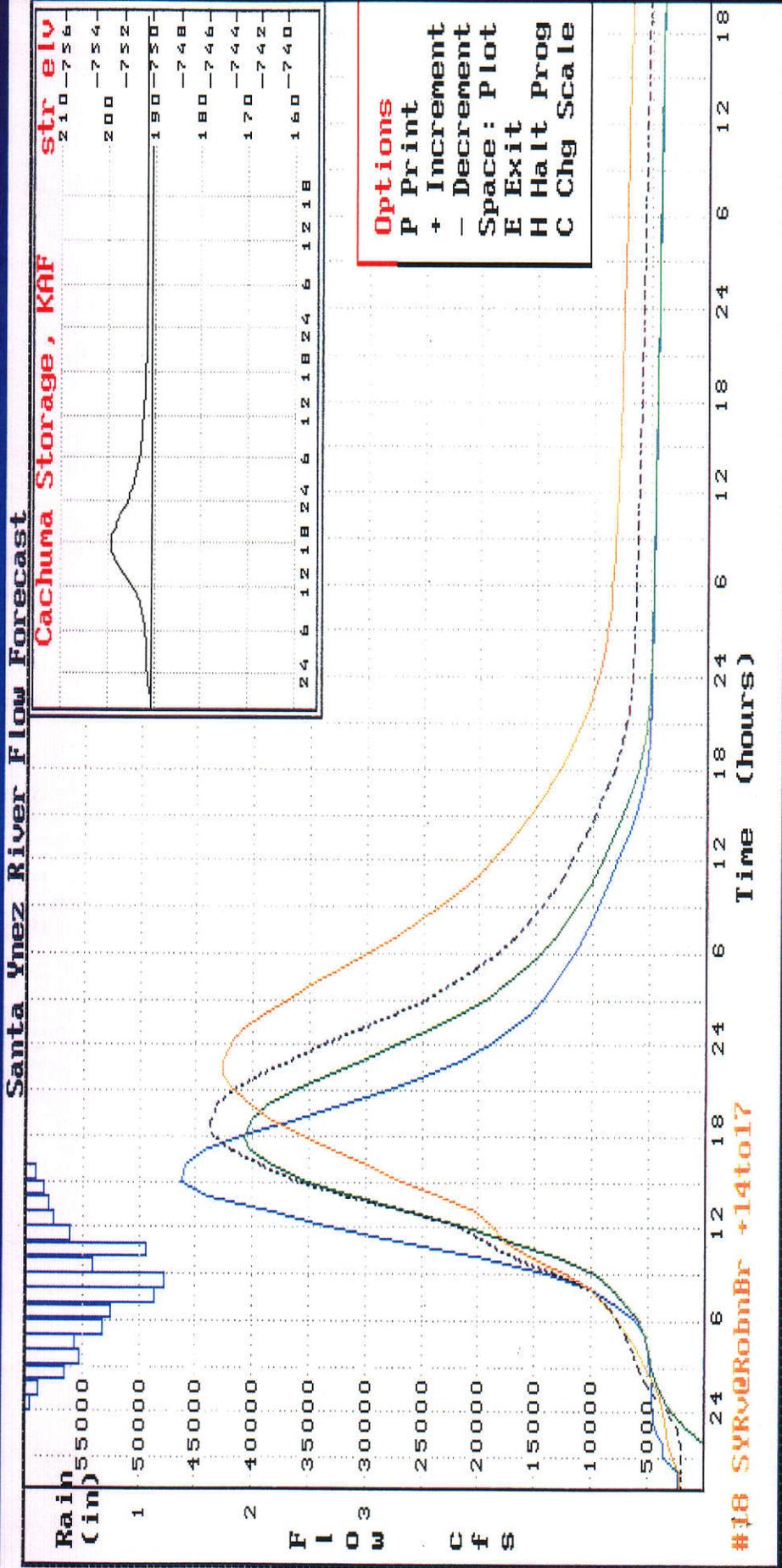


Modified Ops Example - End Spill



Storm of February 23-24, 1998

Peak Flows if Standard Operations Were Used



Cachuma Inflow = 46,000 cfs
 Cachuma Outflow = 40,000 cfs
 SYR @ Lompoc = 43,000 cfs

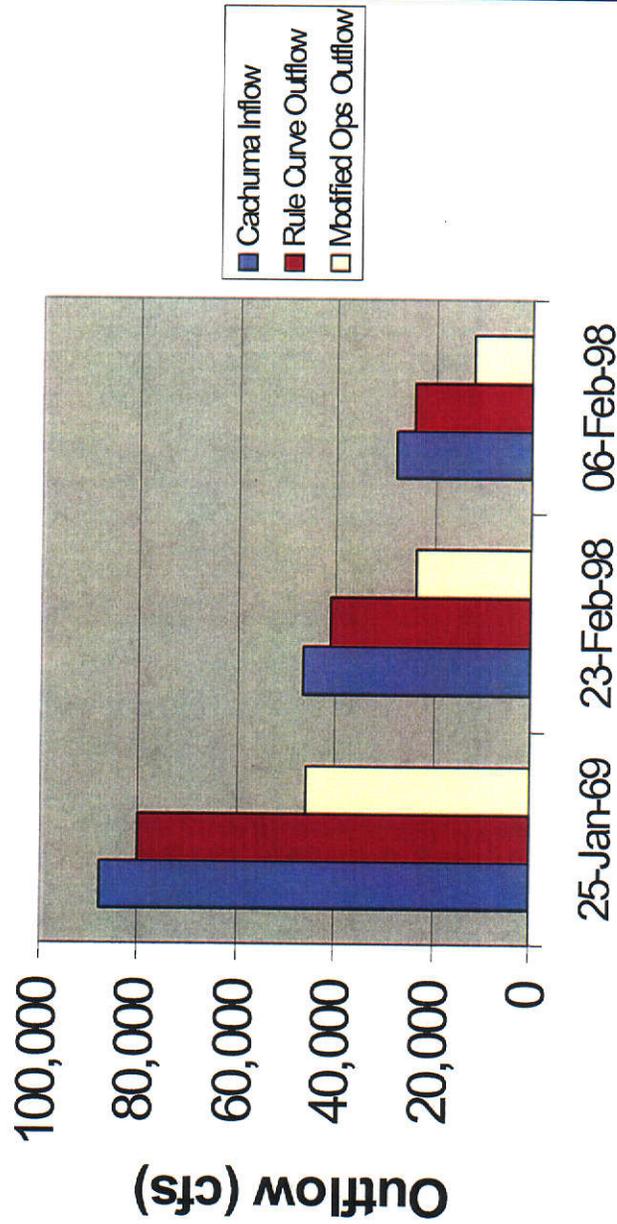
Modified Storm Operations

February 1998 Storm Event

<u>POINT OF MEASURE</u>	<u>FLOW w/o mod ops</u>	<u>FLOW with mod ops</u>	<u>% reduction</u>
Cachuma Inflow	46,000	46,000	N/A
Cachuma Outflow	40,000	23,000	42%
SYR @ Lompoc	43,000	26,000	40%

Modified Storm Operations

Cachuma Outflow Comparison



Storm Event

Historical Operations

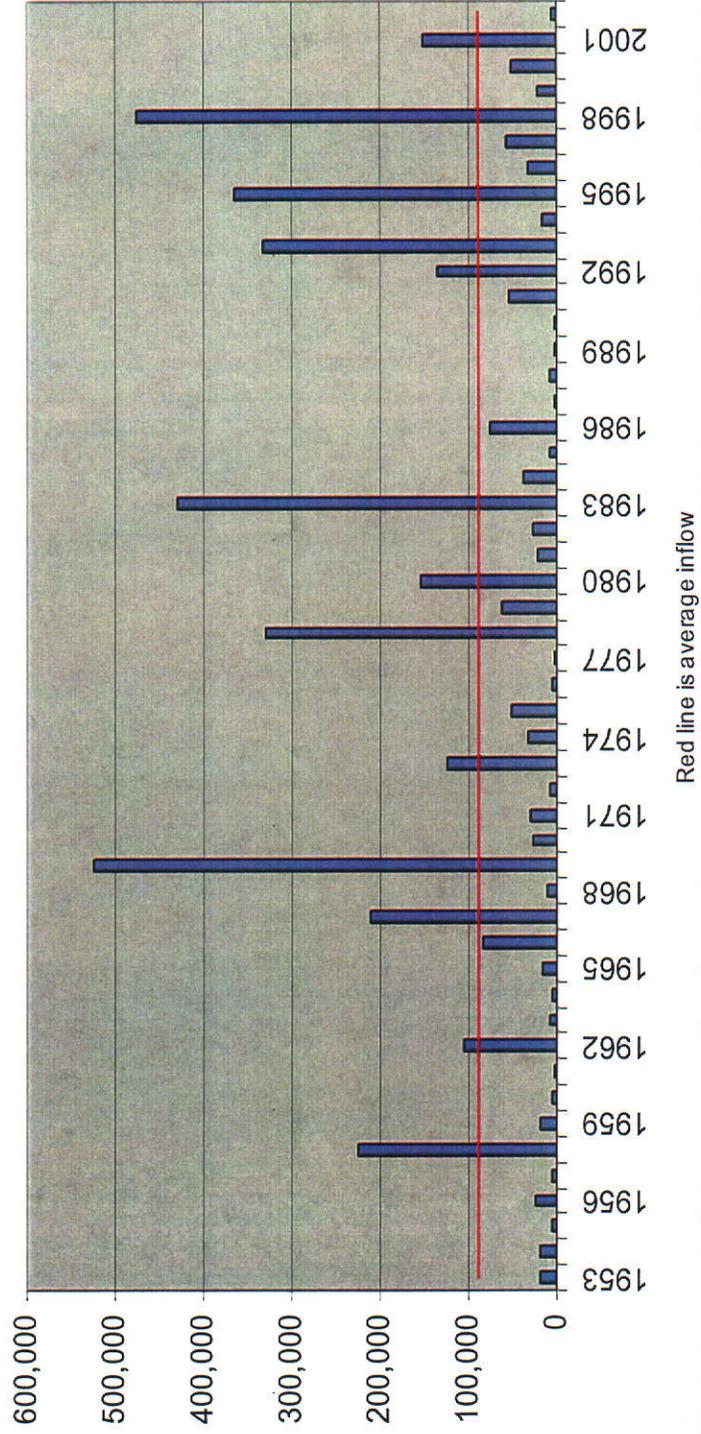
- Average Annual Numbers:
 - State Project Water Inflow: 1,856 acre-feet
 - Gross Evaporation: 11,040 acre-feet
 - Precipitation: 20.51 inches, 4,125 acre-feet
- Average Annual Total Diversions: 78,553 acre-feet
 - Direct Diversion (County Park): 179 acre-feet (1960-2002)
 - Tecolote Tunnel: 19,683 acre-feet (1956-2002)
 - SYRWCD ID#1: 2,571 acre-feet (1960-1997)
 - Downstream Releases: 5,685 acre-feet (excluding releases for fish)
 - Fish Releases: 1,795 acre-feet (1993-2002)
 - Water Rights Releases: 5,327 acre-feet
 - Spills: 144,165 acre-feet (18 years)

Historical Operations

- Average Annual Project Water Deliveries
 - Infiltration into Tecolote Tunnel: 3,138 acre-feet
 - Total Project Deliveries: 24,413 acre-feet (1955-2002)
- Computed Inflow
 - Minimum: 1,910 acre-feet in 1977
 - Maximum: 525,400 acre-feet in 1969
 - Average: 88,647 acre-feet (1953-2002)
 - Below average inflow occurred approximately 75 % of the years
 - Annual computed inflow of less than 25,000 acre-feet occurred approximately 50 % of the years

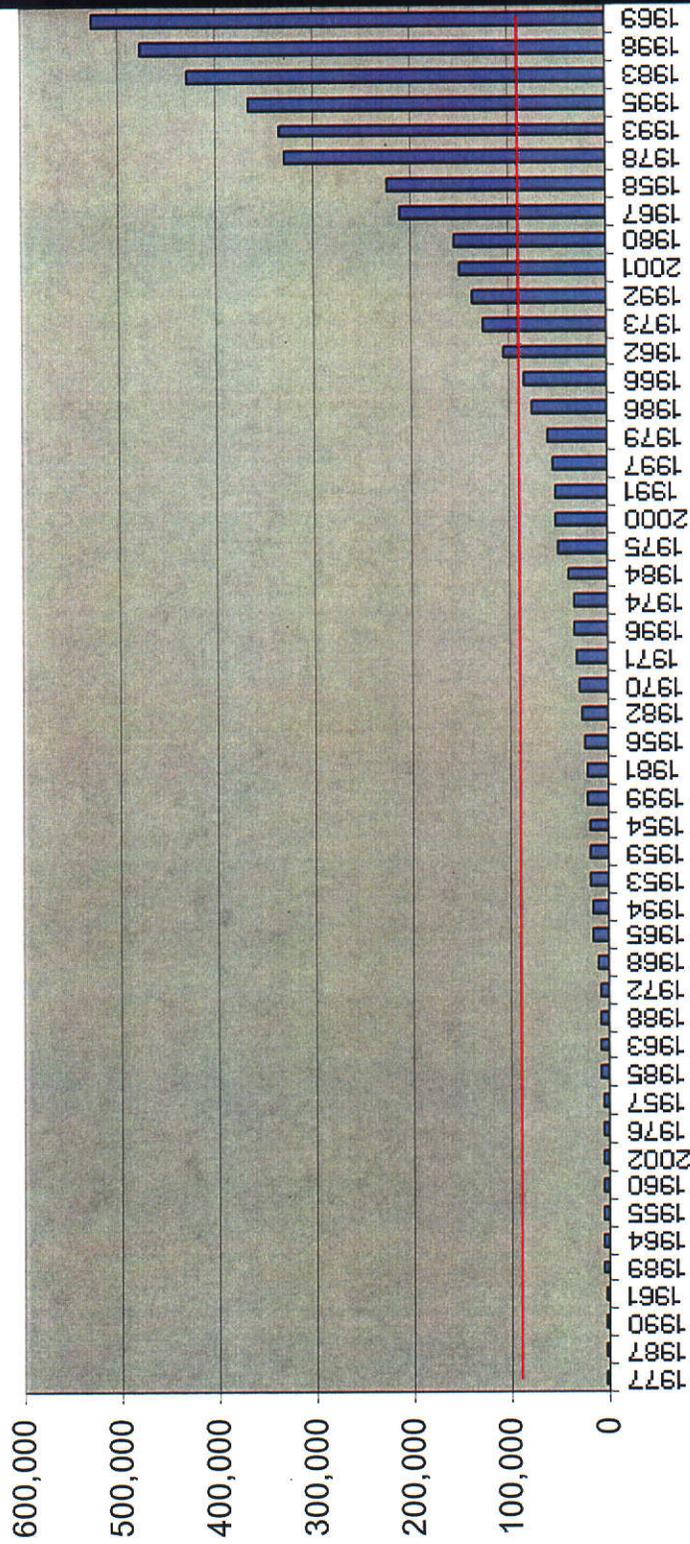
Historical Operations

Inflow to Lake Cachuma - Chronological Order



Historical Operations

Inflow to Lake Cachuma - Ascending Order



Red line is average inflow

The End



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